False Killer Whale TRT – Data Analysis/Mining Work Group

Teleconference #2

March 23, 2010

Attendees: Robin Baird, Tory O'Connell, Andy Read, Ryan Steen, Karin Forney, Erin Oleson, Don Kobayashi, Jamie Marchetti, Michael Marsik, Nancy Young, Scott McCreary, Bennett Brooks

A. Summary of tasks/analyses completed to date

Karin Forney prepared and distributed a handout (Attachment 1) with summaries of additional analyses and processing completed by Michael Marsik, Jamie Marchetti, and Karin Forney since the first TRT meeting and the last Work Group teleconference. The WG discussed each of the six tasks/analyses listed in the handout.

1. <u>Within-set patterns of depredation/hooking</u> (*based on "CatchSum for TRT.xls" spreadsheet; spreadsheet dimensions prevent including as attachment to this summary, but it is posted on the Team website*)

- Comments/clarifications regarding spreadsheet
    - Bigeye tuna and swordfish are target species of deep-sets and shallow-sets, respectively; color-coding of target species allows visual comparison of sets with high vs. low target catch
    - Quality of information is higher in the more recent data because marine mammal damage and float numbers were recorded more reliably
    - Grey color code is for "head only," unsure if marine mammal damage; in early years, likely was marine mammal damage (damage not recorded separately)
- Take-home messages
    - No obvious patterns; depredation along large sections of line
        - Not systematically working from one end of line to the other; maybe encounter gear randomly and work the line one way or the other
    - Many species depredated, but apparent preference for bigeye or unidentified tuna (which may be bigeye that could not be identified as such); no depredation on sharks
    - Apparently more bycatch in the middle of a basket, based on summaries provided by Don and Robin (Attachment 2)
        - Middle of basket is deepest; potentially more slack in the line, increasing risk of animal making a tactical error?
    - Different mechanism in deep-set vs. shallow-set; small sample size for shallow-set, but false killer whales (and Risso's dolphins) likely taking bait in shallow-set, whereas mostly depredation in deep-set
    - Deep-set false killer whale takes closely associated with depredation; addressing the taking of bait unlikely to solve the bycatch problem
- Additional patterns to analyze
    - Examine suggestion that there is less bycatch on floats at either end of the line than floats in the middle
        - On Alaska bottom longlines, lots more gear to get entangled in at either end, and animals avoid the ends

- Majority of interactions occurred in sets with ~90 floats (binned to protect confidentiality) and 25 hooks per float
    - Question about whether this is typical: 25 hooks/float fairly standard
    - Question about whether animals are avoiding floats, and whether decreasing float spacing (shortening distance between floats) might impact bycatch
    - Karin will examine the distribution across all sets of total floats, total hooks, and hooks per float to see if the ~90/25 configuration is simply the most common.

2. <u>Examination of hook type records and mixed hook type trips</u>

- Key findings
    - More recent observer protocols and training are providing more reliable data
        - Examining offset vs. non-offset tuna hooks, and mixed vs. pure hook trips – limit to post-2006
        - Since 2006, ~70% of the observed ~900 trips were pure hook, so sample sizes reasonable
    - "Offset circle hook" designation not available on gear form until May 2005; examining offset vs. non-offset circle hooks – limit to post-May 2005
    - Apparent "switching" between 3.6mm and 3.8mm tuna hooks, or 15/0 and 16/0 circle hooks on the same vessel likely inter-observer scoring differences
    - Few vessels with unusual switching between mixed and non-mixed hook configurations; these could be looked at in further detail or excluded from an analysis to minimize uncertainties.
    - Analysis with the full data set (2003-2009) should be limited to the coarse hook type designations:
        - **J-hook:** combine 8/0 and 9/0; very rarely used in recent years
        - **Tuna hook:** combine 3.8 and 3.6mm sizes
        - **Large circle hook:** 18/0; required by shallow-set fleet
        - **Medium circle-hook:** combine 14/0, 15/0 and 16/0; used by deep-set fleet
- Additional analysis
    - Karin will run additional offset vs. non-offset analyses on the recent subset of the data, beginning in early 2006

3. <u>Create spatio-temporal plots of set locations, depredation, and false killer whales in the deep-set fishery</u>

- Michael is working on plots showing locations of observed sets and sightings of false killer whales and blackfish; sets will be coded to indicate whether there was depredation
- Michael is working to get access to logbook data on fleet effort location with respect to takes and depredation
- Plots will be presented at the April TRT meeting
- Karin will work with Michael to investigate individual vessel processes or patterns, using observer data to plot the sequence of events for some trips during which vessels had takes

4. <u>Vessel effects: do any vessels stand out as having particularly high or low rates of depredation and/or bycatch?</u> (*based on "VesselEffects for TRT.xls" spreadsheet; Attachment 3*)

- Vessel number arbitrarily assigned to protect vessel identity
- For vessels with 100+ sets observed, used scaled deviation to compare those with high or low rates of depredation or bycatch
- A few vessels had lower depredation rates; a few others have high depredation rates but low bycatch rates
- Analysis does not take into account seasonal or spatial differences, # hooks, latitudinal differences, etc.
- Used vessel number in GAM to control for the other factors (Attachment 1, p. 8): there are individual vessel effects (variable ended up in final model)
    - Each bar on plot is relative effect of a vessel; those with mean rates below zero have large error bars, so probably not a meaningful difference
    - At least six vessels have above average depredation rates, with error bars that do not cross zero; these might be vessels of interest
    - Error bars are 1 standard error; relaxing this might pull in a few more vessels
    - To address question of whether higher depredation also means higher bycatch for these vessels, Karin will extract coefficients and cross-reference the datasets
    - Karin noted the overall model only explains 6% of the variation in the data; 94% of variation not explained by variables in model
- Pursuing next steps given confidentiality constraints
    - Share information internally within NMFS, Karin will obtain vessel permit numbers for vessels of interest and send to Don/observer program so they can check with people who know the vessels well (possibly Russ Ito, PIFSC and/or Walter Ikehara, PIRO) or go to docks to see if obvious difference; then determine how to package data or results to share with TRT

5. <u>Conduct additional GAM analyses that include species catch data and environmental variables</u>

- GAM including 15 most common deep-set catch species (Attachment 1, p.4-5)
    - Some species had higher depredation at total higher catch levels; others showed opposite pattern
    - Large percentage of unidentified tunas are depredated (*see "CatchDamage03-09.xls", Attachment 4*) – because depredated tunas may be difficult to identify
    - It was suggested that Karin could prorate unidentified tuna and re-examine depredation relationships, but this was considered a low priority by the group.
- GAM for extended suite of available variables, stepwise selection (Attachment 1, p. 6-8) – discussed during #4 above
- GAM looking at all variables as predictors for false killer whale and blackfish bycatch when animals are known to be interacting with catch or gear (Attachment 1, p. 9-10)
    - Significant factors included year, number of floats, total catch, sea surface temperature, and sea surface height
    - Karin will re-plot figures on same scale to better show relative effect size
- GAM with new hook-type categories and other potential factors (Attachment 1, p.10-11)
    - Mean bycatch for small circle hooks slightly less than tuna hooks, but not statistically significant in GAM; may be interesting to examine in more detail, especially when restricted to more recent time period (2006-2009)
    - Likely no statistically or biologically meaningful vessel differences in bycatch rates

    - Karin will investigate using other statistical techniques (e.g., random forest algorithm, Mantel test)

6. Create 2x2 degree spatial plots with rates of 1) catches of species of interest, 2) depredation, and 3) false killer whale takes in the deep-set fishery

- Very little overlap between bycatch and areas of high depredation
- Depredation likely from both false killer whales and pilot whales; eastern depredation records might be pilot whales
- Behavior of other whales after an animal gets hooked
    - If others stop depredating, it would reduce the percentage of fish depredated in the set
    - Multiple takes have been recorded in a single set; if not hooked simultaneously, it suggests others continuing taking fish after a whale is caught
    - Takes occur in a small percent of sets, and likely aren't driving overall depredation pattern
- Overlap of lancetfish depredation and bycatch is high, but lancetfish often misidentified as marine mammal damage (rather than mechanical damage from normal fishing operation)
- Karin will produce plots of bycatch per unit effort

B. Other discussion topics

- Key points from spreadsheet of all species observed with marine mammal damage (Attachment 4)
    - Whales show preference for bigeye tuna, do not target sharks
    - Average weight of catch species (e.g., mahi) might explain changing depredation rates as catch rate of that species changes. Mahi are widespread but only are getting caught far from the islands.
        - Karin will see whether there is sufficient information in the spatial patterns of mahi weights to investigate this
- Further consideration of higher likelihood of bycatch in the middle of a basket
    - Very few dead: either can carry gear up to surface, or caught when the gear is close to the surface during the haul
    - Evidence mixed on when during fishing the depredation and bycatch are occurring; difficult to assess
    - Geoff McPherson working on array of recorders to pinpoint location of animals working the line; working to put recorders on the fishing line, but concern it would disrupt ability to haul gear

C. Next Steps

- Call summary will be distributed to full TRT
- Karin, Don, Michael, and Jamie will continue to work on analyses
- Analyses, results, and Work Group ideas/discussions will be presented at April TRT meeting
    - Karin will give overview, Work Group members discuss possible interpretation, take-home messages, and possible ways forward

D. Summary of Action Items

- Karin: examine the distribution across all sets of total floats, total hooks, and hooks per float for comparison to sets that caught false killer whales or blackfish

- Karin: run additional offset versus non-offset hook analyses on the recent subset of the data, beginning with early 2006
- Karin: extract coefficients for vessel number from the GAM, and send to Don, Michael, and Jamie
- Don: work with Walter Ikehara (PIRO) to identify whether there are any obvious characteristics of the above vessels of interest
- Karin: re-plot figures for GAM #3 (Attachment 1, p.9-10) to better show effect size
- Karin: investigate using statistical techniques other than GAMs (e.g., random forest algorithm, Mantel test)
- Karin: produce plots of bycatch per unit effort
    - Completed immediately following the call, see Attachment 5
- Karin: determine if there is sufficient information in the spatial patterns of mahi weights to investigate whether catch weight influences depredation rates
- Michael: continue work on spatio-temporal plots to present at April TRT meeting
- Karin: work with Michael to investigate individual vessel processes or patterns, using observer data to plot the sequence of events for some trips during which vessels had takes
- Work Group members: develop list of key points, ideas, and framing questions; email within Work Group for additions and review

No additional Work Group call before TRT meeting

Attachment 1

False Killer Whale Take Reduction Team
DATA WORK GROUP
Second conference call, March 23, 2010
Background materials and updates
(prepared by Karin Forney, 3/21/2010)

Completed observer data processing / examination since March 8 call:

- Continued examining hook type records to get details on mixed hook type trips, and to assess reliability of hook type details (Marchetti)
- Obtained environmental data (remotely sensed SST, SSH, Chlorophyll data, bathymetry, eddy feature data) and merged with observer database (Kobayashi, Forney)
- Extracted additional details on start and end times for set and haul.
- Examined individual vessel rates of depredation and false killer/blackfish whale bycatch to investigate outliers (Forney)
- Continued effort to develop spatio-temporal plots of movements of vessels, depredation, and bycatch (Marsik)

Details and results to date:

1. **Within-set patterns of depredation/hooking** (Forney)**:** A spreadsheet ("*CatchSum for TRT.xls"*) with catch, false killer whale bycatch, and depredation details for each set was distributed on Friday 3/19/2010. This worksheet includes the 42 sets during which a false killer whale was hooked/entangled. Some general observations:
    - False killer whales are caught all along the set (high and low float #s), on a full range of hook #'s within the baskets, with a variety of catch species, and with/without depredation.
    - Species with mammal damage in these sets include:
        - Bigeye tuna (Target species; frequently targeted by false killer whales)
        - Lancetfish (very commonly caught)
        - Yellowfin tuna
        - Swordfish
        - Marlin
        - Snake mackerel
        - Spearfish
        - Opah
        - Mahi (but they are often left untouched in favor of other species)
    - Species that do not appear to be targets of depredation:
        - Sharks do not ever appear to be depredated, although commonly caught
        - Escolar were fairly commonly caught, but not ever depredated.
        - Pomfrets are rarely taken, even if other fish are depredated.

    This spreadsheet is also being forwarded to the Potential Solutions work team to aid in the experimental design of some short-term trials (on Clint's 2 vessels) to examine whether adding objects to the hook increases bait retention. An alternating hook design is not feasible during standard fishing operations, but the catch records suggest that alternating every 5 to 10 baskets would still be meaningful.

2. **<u>Examination of hook type records and mixed hook type trips</u>** (Marchetti)**:**
The focus of this examination was on deep-set trips, because shallow-set trips have all used 18/0 offset circle hooks since the fishery re-opened in 2004. A comprehensive record of hook types recorded during all deep-set trips for each vessel resulted in the following conclusions or discussion points:

a) After observers were given additional training on identifying offset tuna hooks (in May 2004) and recording mixed hook information (early 2006), the frequencies of these characteristics abruptly increased in the data. For example, the percentage of trips with mixed gear was 4.5% before early 2006 compared to almost 28% after:

Pure/Mixed Hook Type Trips

	Total number of trips			Percent of trips	
DEPART_YR	Mixed	Pure	Total	Mixed	Pure
2003	3	120	123	2%	98%
2004	19	311	330	6%	94%
2005	12	258	270	4%	96%
2006	55	179	234	24%	76%
2007	81	165	246	33%	67%
2008	93	149	242	38%	62%
2009	58	152	210	28%	72%
Grand Total	321	1334	1655	19%	81%

The more recent protocols and training are providing more reliable data, so if we are interested in examining offset vs. non-offset tuna hooks, or mixed vs. pure hook trips, we should limit our analyses to the appropriate recent time period (post-2004 or post-2006, respectively) . This will reduce sample sizes, but improve the likelihood of finding actual vs. spurious patterns. Since 2006, about 70% of the observed ~900 trips have been pure, so sample sizes should still be reasonable for analyses.

b) The 'Offset circle hook' designation was not available on the gear form until May 2005, so any investigation of offset vs. non-offset circle hooks would need to be restricted to the post May 2005 period.

c) Following the hook records for individual vessels through time, there is apparent 'switching' back and forth between 3.6mm and 3.8mm tuna hooks, or 15/0 vs. 16/0 circle hooks on the same vessel. This is most likely an indi0cation that these hook sizes are difficult to differentiate, rather than that vessels reconfigured their set of hooks between each trip. For analysis, 3.6 & 3.8 mm and 15/0 & 16/0 should therefore be combined (the less commonly used 14/0 circle hook is also in some cases in the mix, so we could also absorb this in the circle hook group).

d) There are a few vessels that have unusual switching between mixed and non-mixed hook configurations; these could be looked at in further detail or excluded from an analysis to minimize uncertainties.

e) Based on all the above an analysis with the full data set (2003-2009) probably should be limited to the coarse hook type designations of Tuna, Small Circle, J-hook, and Large Circle hooks, as discussed on our previous call:
   J-hook: combine 8/0 and 9/0; very rarely used in recent years
   Tuna hook: combine 3.8 and 3.6mm sizes
   Large circle hook: 18/0; required by shallow-set fleet
   Medium circle-hook: combine 14/0, 15/0 and 16/0; used by deep-set fleet

   For offset vs. non-offset details, we can run additional offset vs non-offset analyses on the recent subset of the data, beginning in early 2006.

3. **Create spatio-temporal plots of set locations, depredation, and false killer whales in the deep-set fishery** (Marsik):

   Mike Marsik met with our Office of Law Enforcement today to ask about the availability of the VMS data to display effort on one or more generic portions of ocean over the course of 12 months. He advised that he could produce the tracks, but it would also include the lines where vessels would be in transit or adrift, etc. and this would complicate interpretation of patterns. On Monday Mike will be contacting personnel regarding logbook data to get a query of the fleet. It should be fast & relatively easy. That way we can get the begin set & end set positions and perhaps link them (with some GIS magic). Mike will also have a slide ready for the next TRT meeting showing all the recorded sightings plotted against the outlines of the islands (a nice sized data set).

4. **Vessel Effects: Do any vessels stand out as having particularly high or low rates of depredation and/or bycatch?** (Forney)

   I have created a spreadsheet that summarizes rates of depredation and false killer whale or unidentified blackfish takes by vessel number (arbitrarily assigned for this summary). I will send this out to the group in a follow-up message after confirming that the information, as presented, is not considered confidential. In this file, I have flagged a few vessels that had interesting patterns of depredation and bycatch rates. Two vessels, in particular, appear to have above average depredation rates with below average bycatch rates. It is not known whether these patterns are caused by vessel differences, or are artifact of areas or times fished.

   I also included VESSEL as a factor in the second GAM analyses below. This has the advantage that we can simultaneously account for other potential confounding factors, such as latitude, longitude, # hooks, soak time, total catch, etc when investigating vessel effects. The GAM results suggest that – once these other factors are taken into account -- there are no vessels with unusually LOW depredation rates, but there are a few that have unusually high depredation rates. We do not have information on some of the variables that have been discussed as possible factors that may enhance detection of vessels by false killer whales (e.g. lights, vessel noise), and we will need to figure out how to go further with this, if desired.

5. **Conduct additional GAM analyses that include species catch data and environmental variables** (Forney)**:**

GAM for most common 15 DSLL catch species, plus some previously sign. set/gear variables:

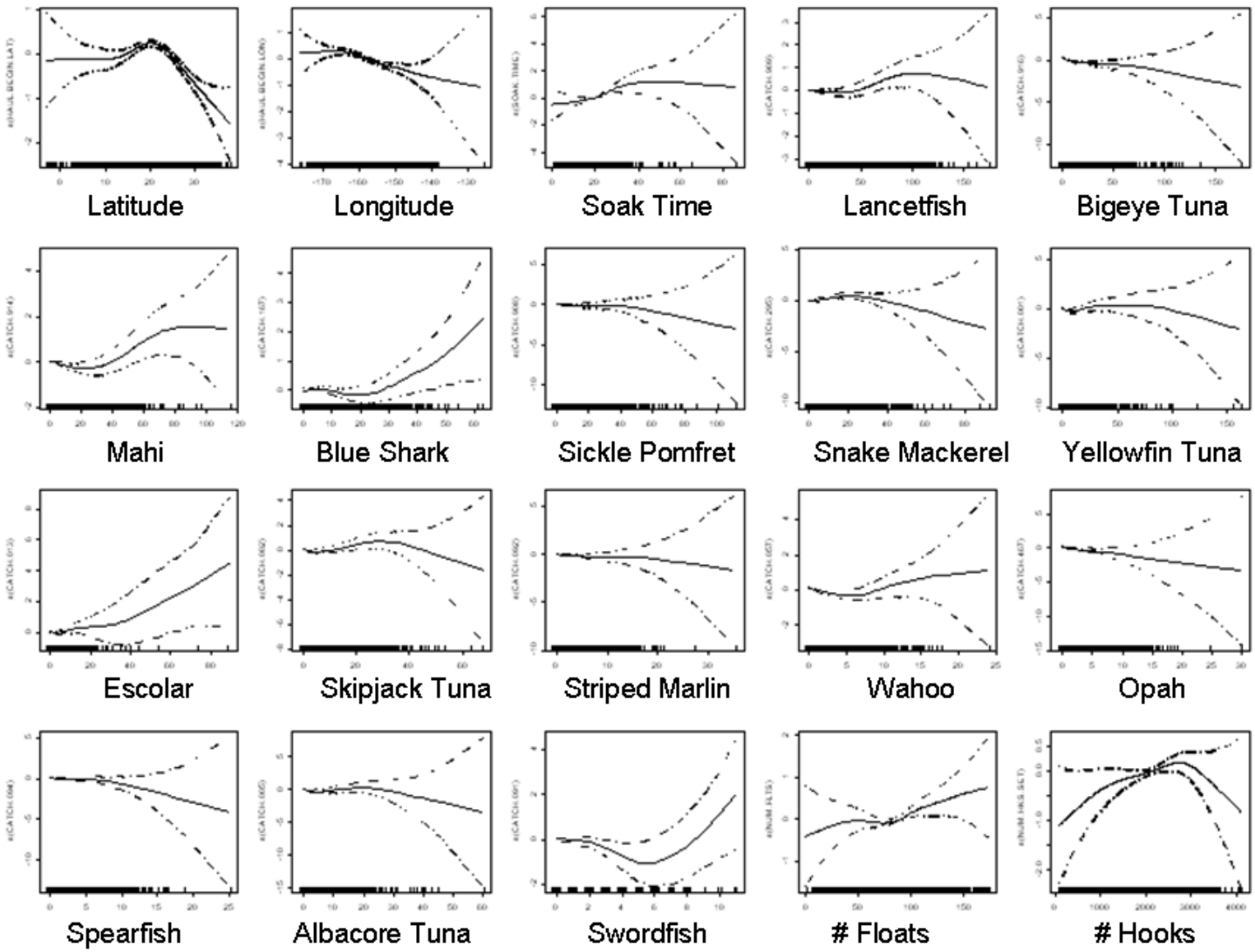
```
 DS.gam <- gam(formula = MM.YN ~  s(HAUL.BEGIN.LAT) + s(HAUL.BEGIN.LON) + s(SOAK.TIME)
+     + s(CATCH.909) + s(CATCH.916) + s(CATCH.914) + s(CATCH.167)
+     + s(CATCH.908) + s(CATCH.295) + s(CATCH.001) + s(CATCH.013)
+     + s(CATCH.002) + s(CATCH.092) + s(CATCH.057) + s(CATCH.467)
+     + s(CATCH.094) + s(CATCH.005) + s(CATCH.091) + s(NUM.FLTS) + s(NUM.HKS.SET),
+     family = binomial(link = logit), data = LLDS, na.action =    na.exclude, control =
+     list(epsilon = 0.001, bf.epsilon = 0.001, maxit = 50, bf.maxit = 10, trace =
FALSE))
> summary(DS.gam)

Deviance Residuals:
       Min         1Q     Median         3Q      Max
 -1.066141 -0.3766659 -0.3161167 -0.2536609 3.018082

(Dispersion Parameter for Binomial family taken to be 1 )

    Null Deviance: 9038.348 on 20679 degrees of freedom
Residual Deviance: 8587.964 on 20603.97 degrees of freedom         ~ 5% explained
deviance

44 observations deleted due to missing values
Number of Local Scoring Iterations: 4

DF for Terms and Chi-squares for Nonparametric Effects

                  Df Npar Df Npar Chisq    P(Chi)
      (Intercept)  1
s(HAUL.BEGIN.LAT)  1     2.8   58.86698 0.0000000
s(HAUL.BEGIN.LON)  1     2.8    7.19198 0.0552830
     s(SOAK.TIME)  1     2.8    7.34240 0.0518091
     s(CATCH.909)  1     2.8    8.56129 0.0300241
     s(CATCH.916)  1     2.6   15.57764 0.0008924
     s(CATCH.914)  1     2.8   15.92911 0.0009897
     s(CATCH.167)  1     2.9   10.57600 0.0128058
     s(CATCH.908)  1     2.6    5.61000 0.0998980
     s(CATCH.295)  1     2.7    7.57677 0.0441546
     s(CATCH.001)  1     2.8   17.09209 0.0005489
     s(CATCH.013)  1     2.9    5.52345 0.1290523
     s(CATCH.002)  1     2.8   15.09776 0.0013623
     s(CATCH.092)  1     2.7    4.76779 0.1614883
     s(CATCH.057)  1     2.9    9.59778 0.0197978
     s(CATCH.467)  1     2.4    2.24852 0.4107506
     s(CATCH.094)  1     2.6    1.70229 0.5667787
     s(CATCH.005)  1     2.6   17.61872 0.0003383
     s(CATCH.091)  1     2.8    9.12106 0.0241070
      s(NUM.FLTS)  1     2.8    8.82325 0.0270042
   s(NUM.HKS.SET)  1     2.8    8.02236 0.0379901
>
```

Plots of the relationships by catch species or other variable are shown on next page.

(Note – these plots are very large and cumbersome in their native S-Plus format, so I've included low-resolution versions to illustrate the shapes of relationships for our discussion. I can provide higher-resolution plots for specific variables of interest if needed -KAF)

Attachment 1

GAM plots for depredation as a function of the most common species caught, plus other variables of interest:



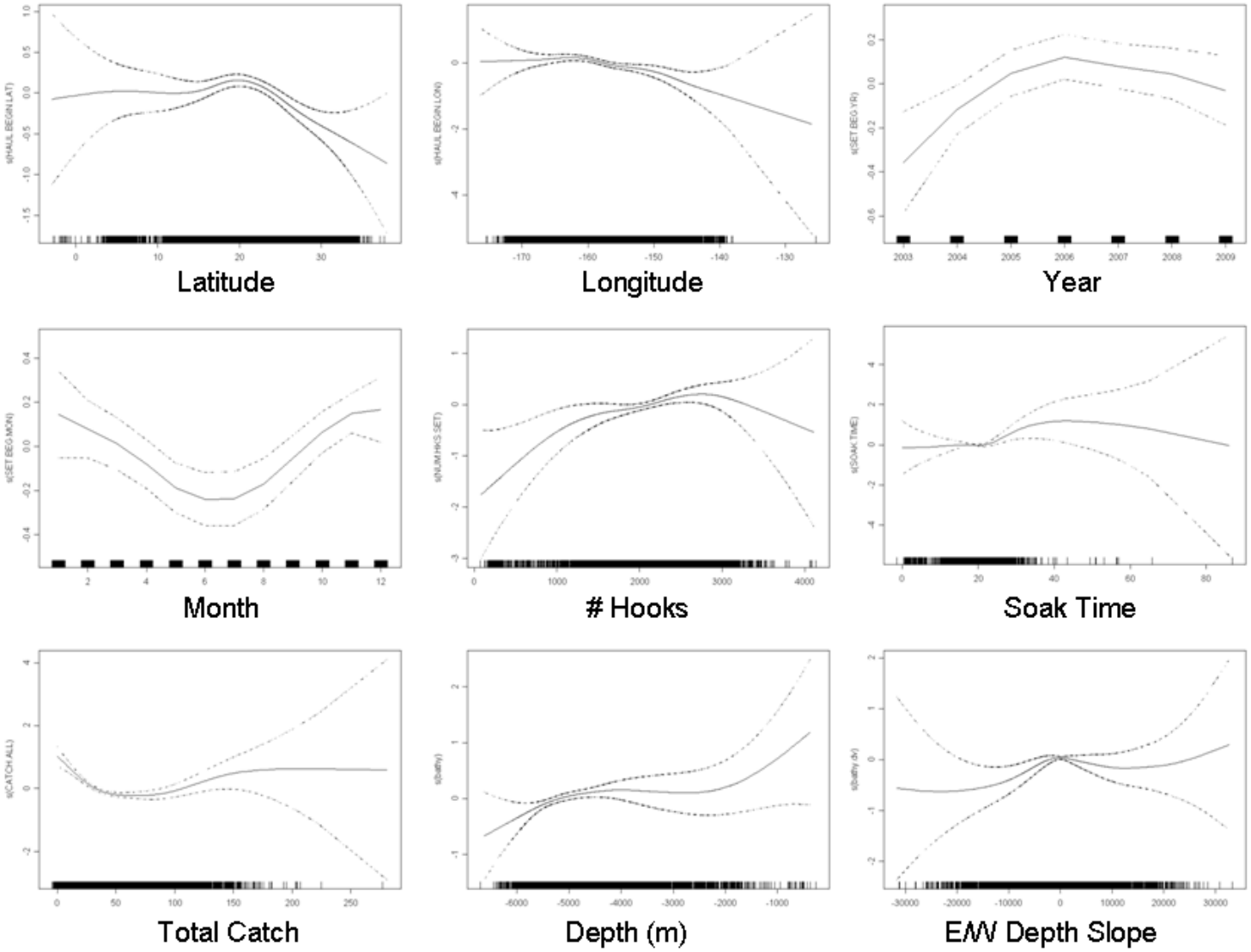
Attachment 1

Stepwise GAM selection for extended suite of available set, gear, vessel, catch total, and environmental variables.

```
# Set up null model:
 > DS.gam0 <- gam(formula = MM.YN ~  1 , family = binomial(link = logit), data = LLDS,
 +     na.action =  na.exclude, control = list(epsilon = 0.001, bf.epsilon = 0.001,
 +      maxit = 50, bf.maxit = 10, trace = FALSE))
#
# run stepwise forward-backwards variable selection (using AIC criteria)
#
  DS.gam.final <- step(DS.gam0, scope=list(
         "HAUL.BEGIN.LAT" = ~ 1  + s(HAUL.BEGIN.LAT),
         "HAUL.BEGIN.LON" = ~ 1  + s(HAUL.BEGIN.LON),
         "HAUL.BEG.DECHR" = ~ 1  + s(HAUL.BEG.DECHR),
         "SET.BEG.YR" = ~ 1  + s(SET.BEG.YR),
         "SET.BEG.MON" = ~ 1  + s(SET.BEG.MON),
         "NUM.FLTS" = ~ 1 + s(NUM.FLTS),
         "NUM.HKS.SET" = ~ 1 + s(NUM.HKS.SET),
         "SOAK.TIME" = ~ 1 + s(SOAK.TIME),
         "VSL" = ~ 1 + VSL,
         "CATCH.ALL" = ~ 1 + s(CATCH.ALL),
         "VESSEL.LEN.FT" = ~ 1 + s(VESSEL.LEN.FT),
         "sst" = ~ 1  + s(sst),
         "ssh" = ~ 1  + s(ssh),
         "u" = ~ 1  + s(u),
         "v" = ~ 1  + s(v),
         "sstgrad" = ~ 1  + s(sstgrad),
         "bathy" = ~ 1  + s(bathy),
         "bathy.du" = ~ 1  + s(bathy.du),
         "bathy.dv" = ~ 1  + s(bathy.dv),
         "seawifs" = ~ 1  + s(seawifs),
         "dist200fm" = ~ 1  + s(dist200fm),
         ))

> summary(DS.gam.final)
Call: gam(formula = MM.YN ~ s(HAUL.BEGIN.LAT) + s(HAUL.BEGIN.LON) + s(SET.BEG.YR) + s(
       SET.BEG.MON) + s(NUM.HKS.SET) + s(SOAK.TIME) + VSL + s(CATCH.ALL) + s(bathy) +
       s(bathy.dv), family = binomial(link = logit), data = LLDS, na.action =
       na.exclude, control = list(epsilon = 0.001, bf.epsilon = 0.001, maxit = 50,
       bf.maxit = 10, trace = FALSE), trace = F)
Deviance Residuals:
        Min         1Q     Median         3Q      Max
 -0.9527118 -0.3850613 -0.3043011 -0.2216443 3.221488
(Dispersion Parameter for Binomial family taken to be 1 )
    Null Deviance: 9043.152 on 20720 degrees of freedom
Residual Deviance: 8443.185 on 20542.07 degrees of freedom     ~6% explained deviance
3 observations deleted due to missing values
Number of Local Scoring Iterations: 5

DF for Terms and Chi-squares for Nonparametric Effects
                   Df Npar Df Npar Chisq     P(Chi)
      (Intercept)   1
s(HAUL.BEGIN.LAT)   1     2.8   21.23802 0.00007284
s(HAUL.BEGIN.LON)   1     3.0    9.70191 0.02119515
    s(SET.BEG.YR)   1     2.9   11.06458 0.00991305
   s(SET.BEG.MON)   1     2.8   22.51110 0.00004084
   s(NUM.HKS.SET)   1     3.0    7.93941 0.04760015
     s(SOAK.TIME)   1     3.0   13.23647 0.00419007
              VSL 143
     s(CATCH.ALL)   1     2.8   63.78012 0.00000000
         s(bathy)   1     2.8    7.20852 0.05671599
      s(bathy.dv)   1     2.8   12.34711 0.00522627
```

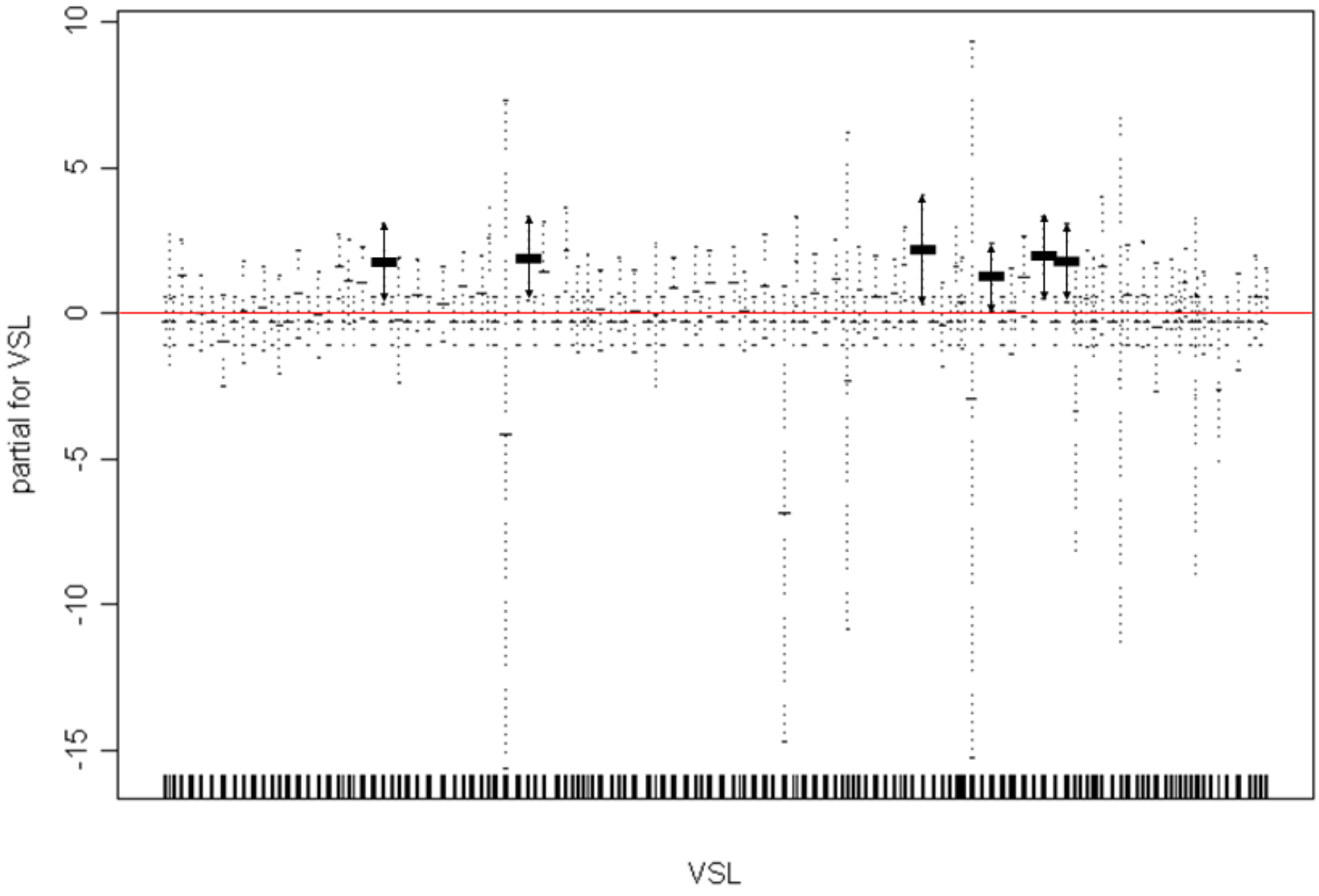
Attachment 1

<u>Plots for variables included in final model</u>: Lat/long, year, month, # hooks and soak time are the most important predictors. The only environmental variables included are bathymetric (added last). Catch still shows an interesting U-shaped effect. Vessel effects appear to be present, but difficult to interpret (see next page for detailed view of this relationship).



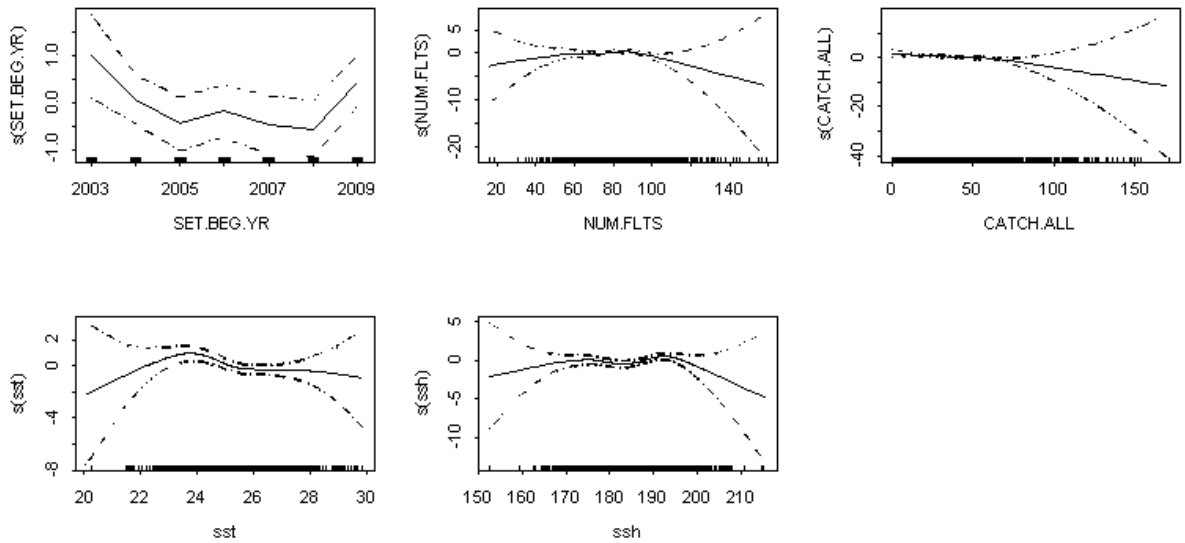
Attachment 1

Vessel effects: Most vessels with below-average depredation rates have wide error bars (~few sets observed), so these are not likely meaningful. A few vessels have above average depredation rates with error bars that do not cross zero (shown with thicker black bars and error ranges), and these may be worth investigating in terms of light, noise, etc. We do not have such information in our current database, so I'm not sure how best to investigate without compromising confidentiality.



GAM to look at all variables as predictors for PC & BF catch when animals are known to be interacting with catch or gear

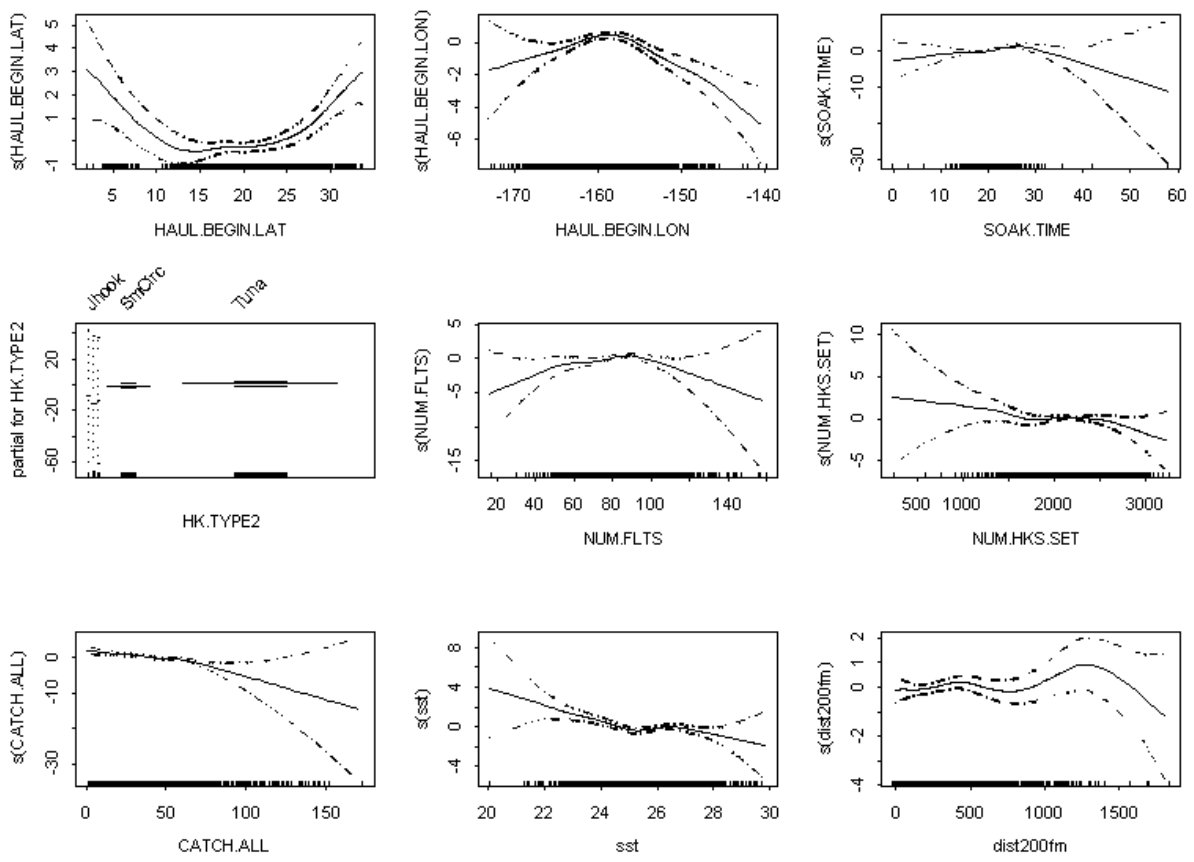
```
DSMM.gam0 <- gam(formula = PCBF.YN  ~  1 ,
+     family = binomial, data = LLDS.MM, na.action =  na.exclude, control =
   list(epsilon = 0.001,
+     bf.epsilon = 0.001, maxit = 50, bf.maxit = 10, trace = FALSE))
>
> DSMM.gam.final <- step(DSMM.gam0, scope=list(
+          "HAUL.BEGIN.LAT" = ~ 1  + s(HAUL.BEGIN.LAT),
+          "HAUL.BEGIN.LON" = ~ 1  + s(HAUL.BEGIN.LON),
+          "HAUL.BEG.DECHR" = ~ 1  + s(HAUL.BEG.DECHR),
+          "HAUL.END.DECHR" = ~ 1  + s(HAUL.END.DECHR),
+          "SET.BEG.YR" = ~ 1  + s(SET.BEG.YR),
+          "SET.BEG.MON" = ~ 1  + s(SET.BEG.MON),
+          "NUM.FLTS" = ~ 1 + s(NUM.FLTS),
+          "HK.TYPE2" = ~ 1 + HK.TYPE2,
+          "NUM.HKS.SET" = ~ 1 + s(NUM.HKS.SET),
+          "SOAK.TIME" = ~ 1 + s(SOAK.TIME),
+          "VSL" = ~ 1 + VSL,
+          "VESSEL.LEN.FT" = ~ 1 + s(VESSEL.LEN.FT),
+          "CATCH.ALL" = ~ 1 + s(CATCH.ALL),
+          "sst" = ~ 1  + s(sst),
+          "ssh" = ~ 1  + s(ssh),
+          "u" = ~ 1  + s(u),
+          "v" = ~ 1  + s(v),
+          "sstgrad" = ~ 1  + s(sstgrad),
+          "bathy" = ~ 1  + s(bathy),
+          "bathy.du" = ~ 1  + s(bathy.du),
+          "bathy.dv" = ~ 1  + s(bathy.dv),
+          "seawifs" = ~ 1  + s(seawifs),
+          "dist200fm" = ~ 1  + s(dist200fm),
+           ))

> summary(DSMM.gam.final)

   Call: gam(formula = PCBF.YN ~ s(SET.BEG.YR) + s(NUM.FLTS) + s(CATCH.AL
   L) +
      s(sst) + s(ssh), family = binomial, data = LLDS.MM, na.action
       = na.exclude, control = list(epsilon = 0.001, bf.epsilon =
      0.001, maxit = 50, bf.maxit = 10, trace = FALSE), trace = F)
   Deviance Residuals:
           Min         1Q     Median         3Q      Max
    -0.7277265 -0.2587238 -0.1850826 -0.1043518 2.900006

   (Dispersion Parameter for Binomial family taken to be 1 )

       Null Deviance: 295.2588 on 1202 degrees of freedom
   Residual Deviance: 242.4275 on 1182.575 degrees of freedom

   1 observations deleted due to missing values
   Number of Local Scoring Iterations: 8

   DF for Terms and Chi-squares for Nonparametric Effects

                 Df Npar Df Npar Chisq    P(Chi)
     (Intercept)  1
   s(SET.BEG.YR)  1     3.0    9.59619 0.0215268
     s(NUM.FLTS)  1     2.9    6.66969 0.0767841
    s(CATCH.ALL)  1     2.8    2.33190 0.4676547
          s(sst)  1     2.8    6.19641 0.0913741
          s(ssh)  1     2.9   10.07212 0.0171137
```



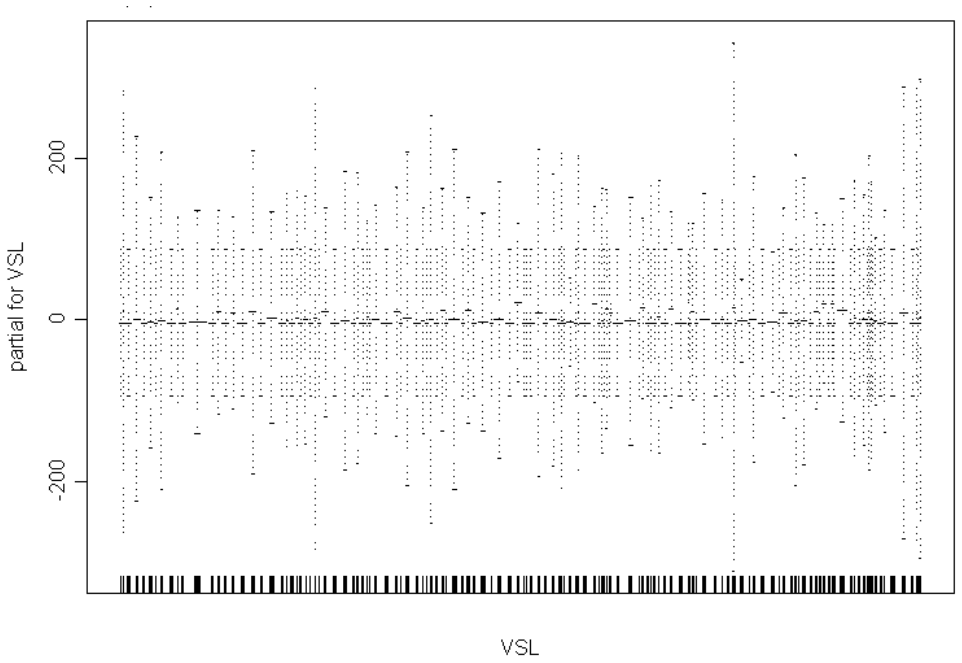
GAM to look at (new) broad hook-type categories (Tuna, J-hook, Lg.Circle, Sm.Circle):

If we force the new hook-type categories into a binomial model with other potential factors:

```
> summary(DSMM.gam)
Call: gam(formula = PCBF.YN ~ s(HAUL.BEGIN.LAT) + s(HAUL.BEGIN.LON) +
   s(SOAK.TIME) + HK.TYPE2 + s(NUM.FLTS) + s(NUM.HKS.SET) + s(CATCH.ALL) +
   s(sst) + s(dist200fm) + VSL, family = binomial,
   data = LLDS.MM, na.action = na.exclude, control = list(
   epsilon = 0.001, bf.epsilon = 0.001, maxit = 50, bf.maxit =
   10, trace = FALSE))

Deviance Residuals:
       Min           1Q       Median           3Q      Max
 -1.328203 -0.005614272 -0.002466625 -0.001103172 2.387031

(Dispersion Parameter for Binomial family taken to be 1 )

    Null Deviance: 295.2588 on 1202 degrees of freedom
Residual Deviance: 139.6181 on 1031.506 degrees of freedom

1 observations deleted due to missing values
Number of Local Scoring Iterations: 11

       DF for Terms and Chi-squares for Nonparametric Effects
                         Df Npar Df Npar Chisq    P(Chi)
             (Intercept)   1
       s(HAUL.BEGIN.LAT)   1     3.0   5.336523 0.1468268
       s(HAUL.BEGIN.LON)   1     2.9   5.140142 0.1568524
            s(SOAK.TIME)   1     2.9   3.297934 0.3298576
                HK.TYPE2   4
             s(NUM.FLTS)   1     3.0   4.013015 0.2574667
          s(NUM.HKS.SET)   1     2.9   2.369168 0.4713442
            s(CATCH.ALL)   1     2.9   2.058984 0.5385279
                  s(sst)   1     3.0   3.118266 0.3708332
            s(dist200fm)   1     3.0   2.379668 0.4929354
                     VSL 135
```

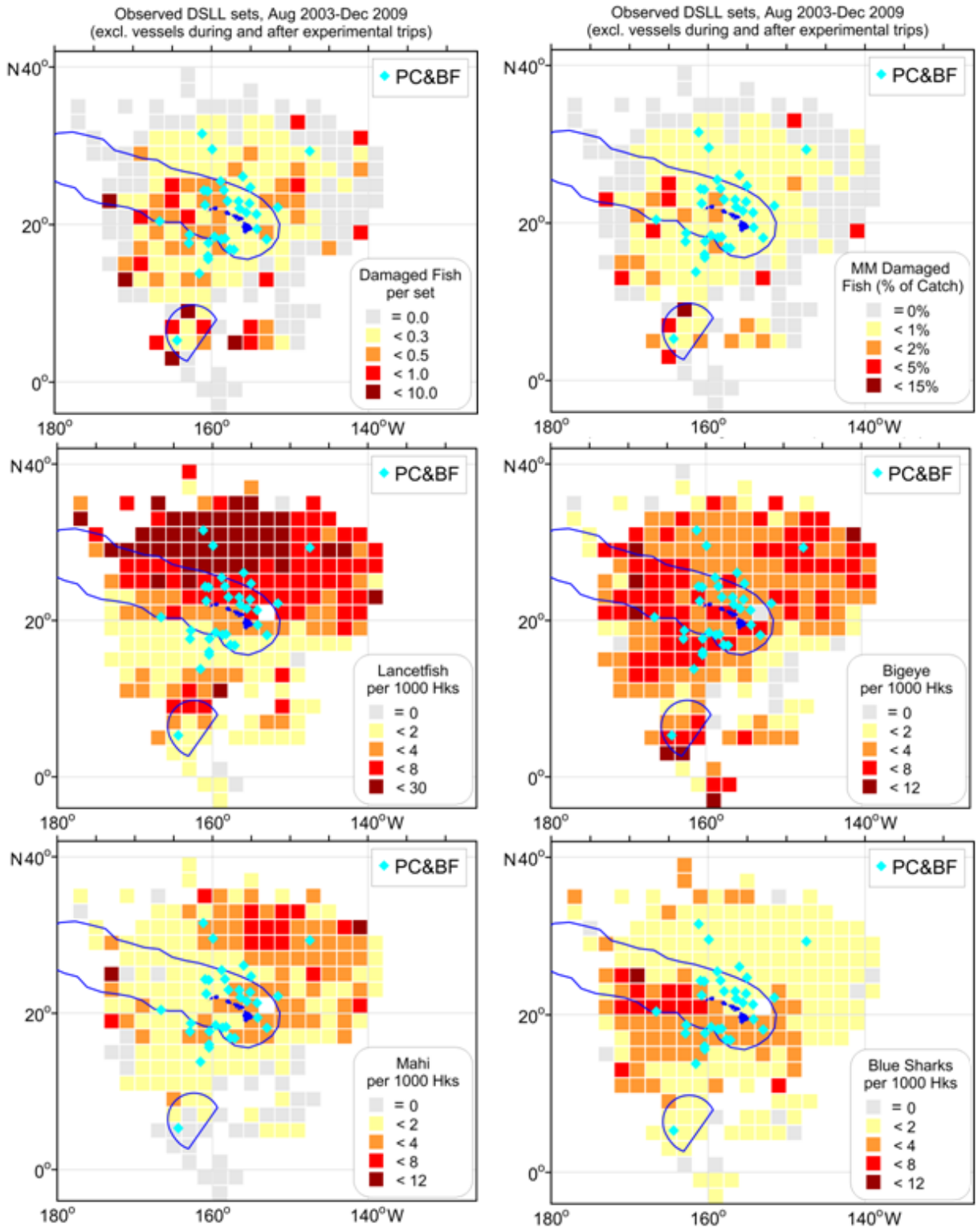


Vessel effects are a bit hard to see, but no vessels stand out as having statistically significant differences in bycatch rates. All are centered around zero with high variances.

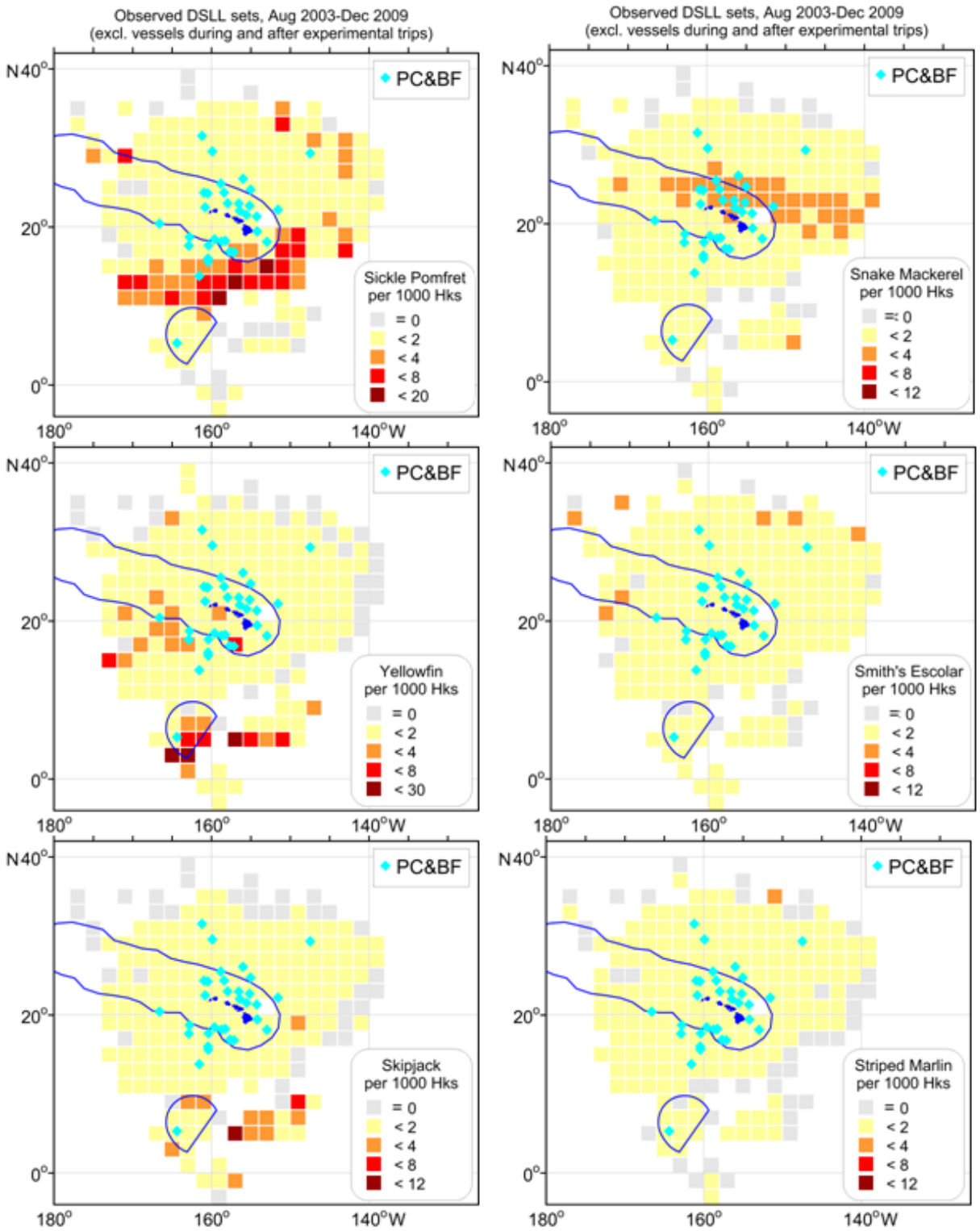


6. Create 2x2 degree spatial plots with rates of 1) catches of species of interest, 2) depredation, and 3) false killer whales takes in the deep-set fishery (Forney).

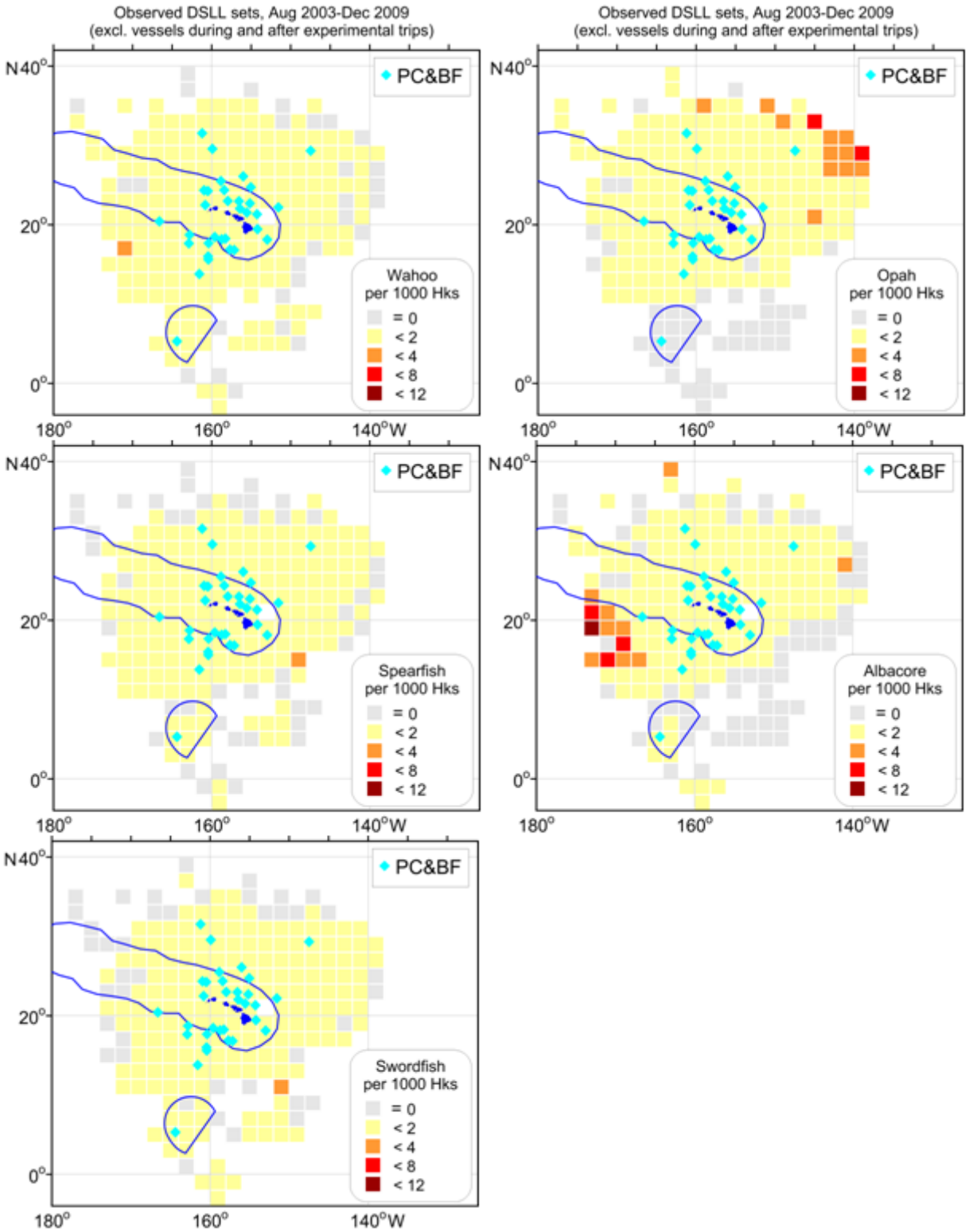
The plots below show depredation rates (fish per set and % of catch), and catch rates of the most commonly caught species in the DSLL fishery. Color scales are kept the same except that maximum is higher in some cases. False killer whale (PC) and unidentified blackfish (BF) takes are overlaid in light blue.



Attachment 1



Attachment 1

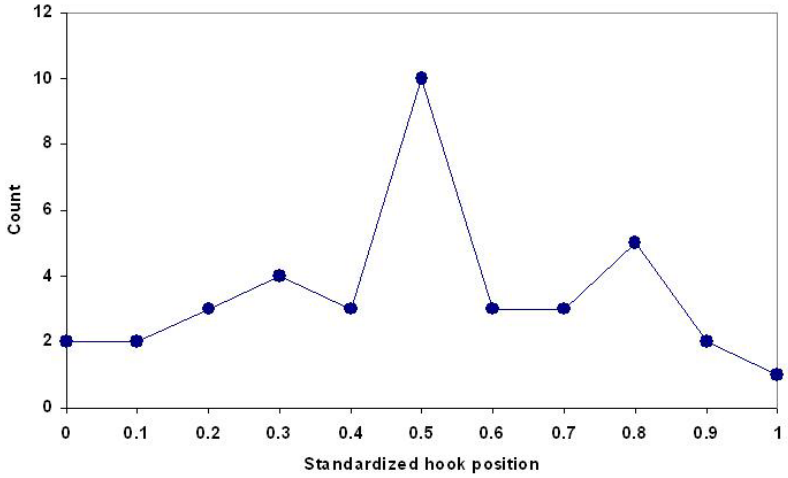


Attachment 2

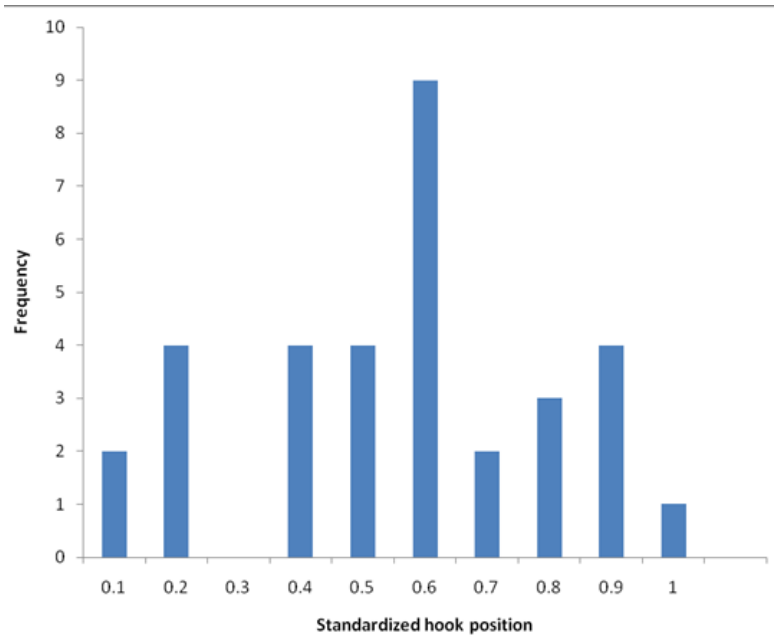
False Killer Whale and Blackfish Bycatch by Hook Position

Prior to the 3-23-10 call, members of the Data Analysis Work Group had some discussions over email about the location of the false killer whale and blackfish takes within a basket.

Don Kobayashi sent the below figure with this explanation: "One thing I noticed in the hook number data was that the pattern does not seem to reflect what should be uniform distribution of takes along a span of hooks if this were not any type of effect. Albeit small sample size there does seem to be a cluster of takes along the mid-portion of the hooks between floats."



Robin Baird replied with the following figure and explanation: "Although I got slightly different values than Don, I thought it would be interesting to exclude the four shallow-set takes, given the much lower take rate in shallow-set fisheries – the graph below only shows deep-set takes. The lack of takes closest to the floats, i.e., the shallowest ones (first and last bin in the graph below) is striking."



SUMMARY OF VESSEL-SPECIFIC DEPREDATION RATES AND TAKE RATES FOR FALSE KILLER WHALES (PC) AND UNIDENTIFIED "BLACKFISH" (BF) IN THE DEEP-SET FISHERY, 2003-2009

(Excludes vessels during and after they were involved in research trips; vessel numbers are arbitrarily assigned to preserve confidentiality)

For each vessel, the (Observed - Expected) / Expected is calculated to examine proportional deviations from the mean rates; this is plotted in the *Histogram* worksheet)

	ALL SETS			SETS WITH DEPREDATION								SETS w/o DEPR.			
Vessel Num	Sets	PCBF	PCBF Rate	Sets	% of all sets	Avg. Expected Depr. Sets	(Obs-Exp)/Exp Depr. Sets	PCBF	Avg. Expected PCBF	(Obs-Exp)/Exp PCBF	PCBF Rate	Sets	PCBF	PCBF Rate	Comments (High/Low rate info is shown only for vessels with at least 100 sets observed to reduce small sample size issues)
1	157	0	0.0%	7	4.5%	9	(0.2)	0	0.1	(0.1)	0%	150	0	0.0%	
2	31	0	0.0%	1	3.2%	2	(0.4)	0	0.0	(0.0)	0%	30	0	0.0%	
3	97	0	0.0%	13	13.4%	6	1.4	0	0.2	(0.2)	0%	84	0	0.0%	
4	196	0	0.0%	11	5.6%	11	(0.0)	0	0.2	(0.2)	0%	185	0	0.0%	
5	161	0	0.0%	8	5.0%	9	(0.1)	0	0.1	(0.1)	0%	153	0	0.0%	
6	207	0	0.0%	10	4.8%	12	(0.2)	0	0.2	(0.2)	0%	197	0	0.0%	
7	192	1	0.5%	5	2.6%	11	(0.5)	1	0.1	0.9	20%	187	0	0.0%	
8	235	1	0.4%	12	5.1%	13	(0.1)	0	0.2	(0.2)	0%	223	1	0.4%	
9	188	0	0.0%	16	8.5%	11	0.5	0	0.3	(0.3)	0%	172	0	0.0%	
10	164	1	0.6%	3	1.8%	9	(0.7)	1	0.1	0.9	33%	161	0	0.0%	Low depredation rate; >100 sets obs
11	197	2	1.0%	11	5.6%	11	(0.0)	1	0.2	0.8	9%	186	1	0.5%	
12	176	0	0.0%	33	18.8%	10	2.3	0	0.6	(0.6)	0%	143	0	0.0%	**High Depr and Low bycatch rate?**
13	158	0	0.0%	12	7.6%	9	0.3	0	0.2	(0.2)	0%	146	0	0.0%	
14	109	0	0.0%	6	5.5%	6	(0.0)	0	0.1	(0.1)	0%	103	0	0.0%	
15	214	0	0.0%	14	6.5%	12	0.1	0	0.3	(0.3)	0%	200	0	0.0%	
16	180	1	0.6%	9	5.0%	10	(0.1)	1	0.2	0.8	11%	171	0	0.0%	
17	197	0	0.0%	19	9.6%	11	0.7	0	0.4	(0.4)	0%	178	0	0.0%	
18	169	0	0.0%	10	5.9%	10	0.0	0	0.2	(0.2)	0%	159	0	0.0%	
19	215	0	0.0%	13	6.0%	12	0.1	0	0.2	(0.2)	0%	202	0	0.0%	
20	173	0	0.0%	19	11.0%	10	0.9	0	0.4	(0.4)	0%	154	0	0.0%	
21	8	0	0.0%	0	0.0%	0	(1.0)					8			
22	173	0	0.0%	12	6.9%	10	0.2	0	0.2	(0.2)	0%	161	0	0.0%	
23	31	0	0.0%	3	9.7%	2	0.7	0	0.1	(0.1)	0%	28	0	0.0%	
24	255	2	0.8%	10	3.9%	15	(0.3)	0	0.2	(0.2)	0%	245	2	0.8%	
25	188	0	0.0%	3	1.6%	11	(0.7)	0	0.1	(0.1)	0%	185	0	0.0%	Low depredation rate; >100 sets obs
26	184	0	0.0%	7	3.8%	10	(0.3)	0	0.1	(0.1)	0%	177	0	0.0%	
27	108	1	0.9%	8	7.4%	6	0.3	1	0.1	0.9	13%	100	0	0.0%	
28	158	1	0.6%	7	4.4%	9	(0.2)	1	0.1	0.9	14%	151	0	0.0%	
29	171	0	0.0%	7	4.1%	10	(0.3)	0	0.1	(0.1)	0%	164	0	0.0%	
30	209	0	0.0%	5	2.4%	12	(0.6)	0	0.1	(0.1)	0%	204	0	0.0%	
31	236	0	0.0%	12	5.1%	13	(0.1)	0	0.2	(0.2)	0%	224	0	0.0%	
32	264	0	0.0%	16	6.1%	15	0.1	0	0.3	(0.3)	0%	248	0	0.0%	
33	172	0	0.0%	16	9.3%	10	0.6	0	0.3	(0.3)	0%	156	0	0.0%	
34	161	0	0.0%	8	5.0%	9	(0.1)	0	0.1	(0.1)	0%	153	0	0.0%	
35	164	0	0.0%	4	2.4%	9	(0.6)	0	0.1	(0.1)	0%	160	0	0.0%	
36	199	0	0.0%	11	5.5%	11	(0.0)	0	0.2	(0.2)	0%	188	0	0.0%	
37	23	0	0.0%	0	0.0%	1	(1.0)					23			
38	44	0	0.0%	3	6.8%	3	0.2	0	0.1	(0.1)	0%	41	0	0.0%	

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	ALL SETS			SETS WITH DEPREDATION								SETS w/o DEPR.			
Vessel Num	Sets	PCBF	PCBF Rate	Sets	% of all sets	Avg. Expected Depr. Sets	(Obs-Exp)/Exp Depr. Sets	PCBF	Avg. Expected PCBF	(Obs-Exp)/Exp PCBF	PCBF Rate	Sets	PCBF	PCBF Rate	Comments (High/Low rate info is shown only for vessels with at least 100 sets observed to reduce small sample size issues)
39	167	0	0.0%	6	3.6%	10	(0.4)	0	0.1	(0.1)	0%	161	0	0.0%	
40	245	1	0.4%	12	4.9%	14	(0.1)	1	0.2	0.8	8%	233	0	0.0%	
41	216	0	0.0%	20	9.3%	12	0.6	0	0.4	(0.4)	0%	196	0	0.0%	Low bycatch rate?
42	154	0	0.0%	9	5.8%	9	0.0	0	0.2	(0.2)	0%	145	0	0.0%	
43	96	0	0.0%	4	4.2%	5	(0.3)	0	0.1	(0.1)	0%	92	0	0.0%	
44	248	0	0.0%	16	6.5%	14	0.1	0	0.3	(0.3)	0%	232	0	0.0%	
45	242	0	0.0%	12	5.0%	14	(0.1)	0	0.2	(0.2)	0%	230	0	0.0%	
46	85	0	0.0%	6	7.1%	5	0.2	0	0.1	(0.1)	0%	79	0	0.0%	
47	150	1	0.7%	4	2.7%	9	(0.5)	1	0.1	0.9	25%	146	0	0.0%	
48	66	0	0.0%	8	12.1%	4	1.1	0	0.1	(0.1)	0%	58	0	0.0%	
49	152	0	0.0%	9	5.9%	9	0.0	0	0.2	(0.2)	0%	143	0	0.0%	
50	7	0	0.0%	0	0.0%	0	(1.0)					7			
51	134	0	0.0%	8	6.0%	8	0.0	0	0.1	(0.1)	0%	126	0	0.0%	
52	198	0	0.0%	4	2.0%	11	(0.6)	0	0.1	(0.1)	0%	194	0	0.0%	
53	219	0	0.0%	20	9.1%	12	0.6	0	0.4	(0.4)	0%	199	0	0.0%	
54	60	0	0.0%	5	8.3%	3	0.5	0	0.1	(0.1)	0%	55	0	0.0%	
55	143	0	0.0%	11	7.7%	8	0.4	0	0.2	(0.2)	0%	132	0	0.0%	
56	248	0	0.0%	7	2.8%	14	(0.5)	0	0.1	(0.1)	0%	241	0	0.0%	
57	233	1	0.4%	20	8.6%	13	0.5	1	0.4	0.6	5%	213	0	0.0%	
58	72	0	0.0%	5	6.9%	4	0.2	0	0.1	(0.1)	0%	67	0	0.0%	
59	185	0	0.0%	17	9.2%	11	0.6	0	0.3	(0.3)	0%	168	0	0.0%	
60	221	0	0.0%	14	6.3%	13	0.1	0	0.3	(0.3)	0%	207	0	0.0%	
61	234	0	0.0%	11	4.7%	13	(0.2)	0	0.2	(0.2)	0%	223	0	0.0%	
62	123	1	0.8%	7	5.7%	7	0.0	1	0.1	0.9	14%	116	0	0.0%	
63	91	0	0.0%	1	1.1%	5	(0.8)	0	0.0	(0.0)	0%	90	0	0.0%	
64	232	0	0.0%	12	5.2%	13	(0.1)	0	0.2	(0.2)	0%	220	0	0.0%	
65	223	1	0.4%	11	4.9%	13	(0.1)	1	0.2	0.8	9%	212	0	0.0%	
66	209	1	0.5%	9	4.3%	12	(0.2)	1	0.2	0.8	11%	200	0	0.0%	
67	28	0	0.0%	0	0.0%	2	(1.0)					28			
68	158	1	0.6%	12	7.6%	9	0.3	0	0.2	(0.2)	0%	146	1	0.7%	
69	193	1	0.5%	4	2.1%	11	(0.6)	0	0.1	(0.1)	0%	189	1	0.5%	
70	198	0	0.0%	2	1.0%	11	(0.8)	0	0.0	(0.0)	0%	196	0	0.0%	Low depredation rate; >100 sets obs
71	137	0	0.0%	5	3.6%	8	(0.4)	0	0.1	(0.1)	0%	132	0	0.0%	
72	260	1	0.4%	13	5.0%	15	(0.1)	1	0.2	0.8	8%	247	0	0.0%	
73	84	0	0.0%	5	6.0%	5	0.0	0	0.1	(0.1)	0%	79	0	0.0%	
74	27	0	0.0%	1	3.7%	2	(0.3)	0	0.0	(0.0)	0%	26	0	0.0%	
75	242	1	0.4%	19	7.9%	14	0.4	0	0.4	(0.4)	0%	223	1	0.4%	
76	185	0	0.0%	7	3.8%	11	(0.3)	0	0.1	(0.1)	0%	178	0	0.0%	

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	ALL SETS			SETS WITH DEPREDATION								SETS w/o DEPR.			
Vessel Num	Sets	PCBF	PCBF Rate	Sets	% of all sets	Avg. Expected Depr. Sets	(Obs-Exp)/Exp Depr. Sets	PCBF	Avg. Expected PCBF	(Obs-Exp)/Exp PCBF	PCBF Rate	Sets	PCBF	PCBF Rate	Comments (High/Low rate info is shown only for vessels with at least 100 sets observed to reduce small sample size issues)
77	211	0	0.0%	6	2.8%	12	(0.5)	0	0.1	(0.1)	0%	205	0	0.0%	
78	178	0	0.0%	3	1.7%	10	(0.7)	0	0.1	(0.1)	0%	175	0	0.0%	Low depredation rate; >100 sets obs
79	71	0	0.0%	2	2.8%	4	(0.5)	0	0.0	(0.0)	0%	69	0	0.0%	
80	118	0	0.0%	6	5.1%	7	(0.1)	0	0.1	(0.1)	0%	112	0	0.0%	
81	116	0	0.0%	2	1.7%	7	(0.7)	0	0.0	(0.0)	0%	114	0	0.0%	Low depredation rate; >100 sets obs
82	80	1	1.3%	3	3.8%	5	(0.3)	0	0.1	(0.1)	0%	77	1	1.3%	
83	169	0	0.0%	16	9.5%	10	0.7	0	0.3	(0.3)	0%	153	0	0.0%	
84	219	0	0.0%	22	10.0%	12	0.8	0	0.4	(0.4)	0%	197	0	0.0%	
85	151	0	0.0%	3	2.0%	9	(0.7)	0	0.1	(0.1)	0%	148	0	0.0%	Low depredation rate; >100 sets obs
86	162	2	1.2%	8	4.9%	9	(0.1)	2	0.1	1.9	25%	154	0	0.0%	2PC caught in single set
87	77	0	0.0%	8	10.4%	4	0.8	0	0.1	(0.1)	0%	69	0	0.0%	**High Depredation rate**
88	80	0	0.0%	1	1.3%	5	(0.8)	0	0.0	(0.0)	0%	79	0	0.0%	
89	195	0	0.0%	9	4.6%	11	(0.2)	0	0.2	(0.2)	0%	186	0	0.0%	
90	193	0	0.0%	5	2.6%	11	(0.5)	0	0.1	(0.1)	0%	188	0	0.0%	
91	210	1	0.5%	12	5.7%	12	0.0	1	0.2	0.8	8%	198	0	0.0%	
92	123	0	0.0%	6	4.9%	7	(0.1)	0	0.1	(0.1)	0%	117	0	0.0%	
93	162	0	0.0%	22	13.6%	9	1.4	0	0.4	(0.4)	0%	140	0	0.0%	**High Depr and Low bycatch rate?**
94	66	0	0.0%	1	1.5%	4	(0.7)	0	0.0	(0.0)	0%	65	0	0.0%	
95	39	0	0.0%	4	10.3%	2	0.8	0	0.1	(0.1)	0%	35	0	0.0%	
96	87	0	0.0%	5	5.7%	5	0.0	0	0.1	(0.1)	0%	82	0	0.0%	
97	24	0	0.0%	5	20.8%	1	2.7	0	0.1	(0.1)	0%	19	0	0.0%	
98	217	0	0.0%	19	8.8%	12	0.5	0	0.4	(0.4)	0%	198	0	0.0%	Low bycatch rate?
99	156	0	0.0%	14	9.0%	9	0.6	0	0.3	(0.3)	0%	142	0	0.0%	
100	213	0	0.0%	5	2.3%	12	(0.6)	0	0.1	(0.1)	0%	208	0	0.0%	
101	199	1	0.5%	11	5.5%	11	(0.0)	0	0.2	(0.2)	0%	188	1	NA	
102	138	0	0.0%	5	3.6%	8	(0.4)	0	0.1	(0.1)	0%	133	0	0.0%	
103	15	0	0.0%	1	6.7%	1	0.2	0	0.0	(0.0)	0%	14	0	0.0%	
104	276	0	0.0%	18	6.5%	16	0.1	0	0.3	(1.0)	0%	258	0	0.0%	**Avg Depr; Low bycatch rate?**
105	103	1	1.0%	3	2.9%	6	(0.5)	1	0.1	0.9	33%	100	0	0.0%	
106	260	0	0.0%	11	4.2%	15	(0.3)	0	0.2	(0.2)	0%	249	0	0.0%	
107	201	1	0.5%	13	6.5%	11	0.1	0	0.2	(0.2)	0%	188	1	0.5%	
108	220	2	0.9%	17	7.7%	13	0.4	2	0.3	1.7	12%	203	0	0.0%	**High bycatch rate?**
109	31	0	0.0%	2	6.5%	2	0.1	0	0.0	(0.0)	0%	29	0	0.0%	
110	59	0	0.0%	0	0.0%	3	(1.0)					59			
111	124	0	0.0%	13	10.5%	7	0.8	0	0.2	(0.2)	0%	111	0	0.0%	
112	107	0	0.0%	9	8.4%	6	0.5	0	0.2	(0.2)	0%	98	0	0.0%	
113	74	1	1.4%	5	6.8%	4	0.2	1	0.1	0.9	20%	69	0	0.0%	
114	14	0	0.0%	0	0.0%	1	(1.0)					14			

SUMMARY OF VESSEL-SPECIFIC DEPREDATION RATES AND TAKE RATES FOR FALSE KILLER WHALES (PC) AND UNIDENTIFIED "BLACKFISH" (BF) IN THE DEEP-SET FISHERY, 2003-2009

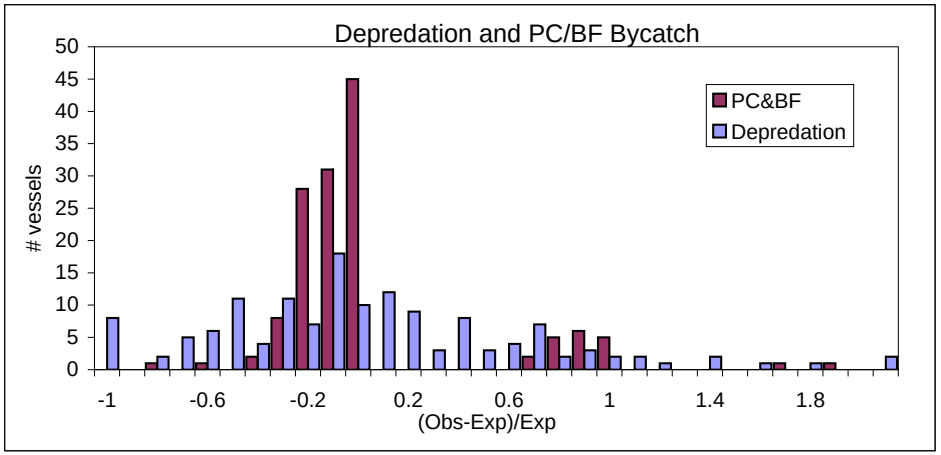
(Excludes vessels during and after they were involved in research trips; vessel numbers are arbitrarily assigned to preserve confidentiality)

For each vessel, the (Observed - Expected) / Expected is calculated to examine proportional deviations from the mean rates; this is plotted in the *Histogram* worksheet)

	ALL SETS			SETS WITH DEPREDATION								SETS w/o DEPR.			
Vessel Num	Sets	PCBF	PCBF Rate	Sets	% of all sets	Avg. Expected Depr. Sets	(Obs-Exp)/Exp Depr. Sets	PCBF	Avg. Expected PCBF	(Obs-Exp)/Exp PCBF	PCBF Rate	Sets	PCBF	PCBF Rate	Comments (High/Low rate info is shown only for vessels with at least 100 sets observed to reduce small sample size issues)
115	69	0	0.0%	4	5.8%	4	0.0	0	0.1	(0.1)	0%	65	0	0.0%	
116	160	0	0.0%	12	7.5%	9	0.3	0	0.2	(0.2)	0%	148	0	0.0%	
117	225	0	0.0%	8	3.6%	13	(0.4)	0	0.1	(0.1)	0%	217	0	0.0%	
118	52	1	1.9%	8	15.4%	3	1.7	1	0.1	0.9	13%	44	0	0.0%	
119	18	0	0.0%	2	11.1%	1	1.0	0	0.0	(0.0)	0%	16	0	0.0%	
120	207	0	0.0%	9	4.3%	12	(0.2)	0	0.2	(0.2)	0%	198	0	0.0%	
121	130	0	0.0%	7	5.4%	7	(0.1)	0	0.1	(0.1)	0%	123	0	0.0%	
122	97	0	0.0%	3	3.1%	6	(0.5)	0	0.1	(0.1)	0%	94	0	0.0%	
123	89	0	0.0%	3	3.4%	5	(0.4)	0	0.1	(0.1)	0%	86	0	0.0%	
124	228	0	0.0%	20	8.8%	13	0.5	0	0.4	(0.4)	0%	208	0	0.0%	
125	137	0	0.0%	7	5.1%	8	(0.1)	0	0.1	(0.1)	0%	130	0	0.0%	
126	71	0	0.0%	4	5.6%	4	(0.0)	0	0.1	(0.1)	0%	67	0	0.0%	
127	76	0	0.0%	9	11.8%	4	1.1	0	0.2	(0.2)	0%	67	0	0.0%	
128	52	0	0.0%	6	11.5%	3	1.0	0	0.1	(0.1)	0%	46	0	0.0%	
129	47	0	0.0%	0	0.0%	3	(1.0)					47			
130	99	1	1.0%	2	2.0%	6	(0.6)	0	0.0	(0.0)	0%	97	1	1.0%	
131	121	0	0.0%	3	2.5%	7	(0.6)	0	0.1	(0.1)	0%	118	0	0.0%	
132	7	0	0.0%	1	14.3%	0	1.5	0	0.0	(0.0)	0%	6	0	0.0%	
133	13	0	0.0%	0	0.0%	1	(1.0)					13			
134	40	0	0.0%	2	5.0%	2	(0.1)	0	0.0	(0.0)	0%	38	0	0.0%	
135	51	0	0.0%	2	3.9%	3	(0.3)	0	0.0	(0.0)	0%	49	0	0.0%	
136	108	0	0.0%	6	5.6%	6	(0.0)	0	0.1	(0.1)	0%	102	0	0.0%	
137	175	0	0.0%	9	5.1%	10	(0.1)	0	0.2	(0.2)	0%	166	0	0.0%	
138	114	0	0.0%	4	3.5%	6	(0.4)	0	0.1	(0.1)	0%	110	0	0.0%	
139	199	1	0.5%	19	9.5%	11	0.7	1	0.4	0.6	5%	180	0	0.0%	
140	255	0	0.0%	15	5.9%	15	0.0	0	0.3	(0.3)	0%	240	0	0.0%	
141	140	0	0.0%	11	7.9%	8	0.4	0	0.2	(0.2)	0%	129	0	0.0%	
142	83	0	0.0%	1	1.2%	5	(0.8)	0	0.0	(0.0)	0%	82	0	0.0%	
143	114	0	0.0%	3	2.6%	6	(0.5)	0	0.1	(0.1)	0%	111	0	0.0%	
144	80	0	0.0%	4	5.0%	5	(0.1)	0	0.1	(0.1)	0%	76	0	0.0%	
TOTALS	**20724**	**33**	**0.16%**	**1179**	**5.7%**			**22**			**1.87%**	**19545**	**11**	**0.1%**	

Bin	*PC&BF*
-1	0
-0.9	0
-0.8	1
-0.7	0
-0.6	1
-0.5	0
-0.4	2
-0.3	8
-0.2	28
-0.1	31
0	45
0.1	0
0.2	0
0.3	0
0.4	0
0.5	0
0.6	0
0.7	2
0.8	5
0.9	6
1	5
1.1	0
1.2	0
1.3	0
1.4	0
1.5	0
1.6	0
1.7	1
1.8	0
1.9	1
2	0
More	0

Bin	*Depr*
-1	8
-0.9	0
-0.8	2
-0.7	5
-0.6	6
-0.5	11
-0.4	4
-0.3	11
-0.2	7
-0.1	18
0	10
0.1	12
0.2	9
0.3	3
0.4	8
0.5	3
0.6	4
0.7	7
0.8	2
0.9	3
1	2
1.1	2
1.2	1
1.3	0
1.4	2
1.5	0
1.6	1
1.7	0
1.8	1
1.9	0
2	0
More	2



Species Code	Species common name	BD	CC	CO	MM	ND	SB	SH	SQ	ST	SW	UN	UO	TOTAL CATCH
916	Bigeye Tuna	15	12066	158	1282	166106	1211	753	608	495	3	81	113	182891
006	Unid. tuna	0	14	17	966	256	56	362	8	5	0	24	90	1798
914	Mahi	20	3518	100	422	96966	550	1168	1547	86	0	76	273	104726
091	Swordfish	2710	20176	1009	345	62290	1326	413	484	492	2	70	344	89661
057	Wahoo	6	725	29	196	17518	271	384	211	79	0	38	10	19467
094	Shortbill Spearfish	3	386	19	191	15404	172	294	126	44	0	16	29	16684
089	Unid. billfish	1	1	9	183	98	5	44	0	0	0	10	33	384
002	Skipjack Tuna	6	1413	73	177	26992	621	613	1001	297	0	84	62	31339
001	Yellowfin Tuna	8	2562	46	167	34621	665	342	254	147	1	20	19	38852
909	Longnose Lancetfish	4	471	652	161	219388	870	1781	2916	549	0	1331	4563	232686
092	Striped Marlin	3	643	26	149	21441	224	183	94	51	0	22	53	22889
908	Sickle Pomfret	2	992	6	124	63980	79	137	61	40	0	21	28	65470
467	Opah	0	2249	14	84	16109	71	15	77	17	0	18	30	18684
013	Smith's Escolar	48	3876	91	64	37634	513	329	455	98	0	44	88	43240
005	Albacore Tuna	24	408	17	62	21261	167	171	133	111	0	11	22	22387
295	Snake Mackerel	7	169	68	41	55632	331	466	2192	192	0	238	851	60187
700	Unid. bony fish	0	3	12	34	409	6	47	8	2	0	42	146	709
093	Blue Marlin	0	93	6	21	5491	92	12	17	12	0	4	12	5760
131	Great Barracuda	0	3	0	5	2862	8	10	0	3	0	0	4	2895
298	Slender Mola	0	3	0	5	2026	7	10	13	2	0	0	2	2068
054	Longfin Escolar	0	7	2	4	783	4	6	28	3	0	15	5	857
095	Sailfish	0	13	0	3	458	6	2	1	0	0	0	2	485
906	Crestfish	0	9	1	3	332	2	3	21	0	0	1	3	375
910	Other bony fish	0	3	1	3	264	1	2	7	0	0	2	3	286
058	Rainbow Runner	0	2	0	2	62	1	3	1	2	0	1	0	74
147	Bigeye Thresher Shark	0	4	2	1	7142	4	0	0	0	0	5	160	7318
901	Tapertail Ribbonfish	0	10	0	1	163	2	0	5	0	0	2	1	184
004	Bluefin Tuna	0	0	0	0	5	0	0	0	0	0	0	0	5
014	Oilfish	7	82	5	0	2142	20	13	21	8	0	2	5	2305
040	Yellowtail	0	0	0	0	2	0	0	0	0	0	0	0	2
042	Cottonmouth Jack	0	0	0	0	37	0	0	1	0	0	2	0	40
051	Pacific Mackerel	0	0	0	0	1	0	0	0	0	0	0	0	1
053	Razorback Scabbardfish	0	0	0	0	116	0	0	7	2	0	0	1	126
056	Roudi's Escolar	0	4	0	0	196	2	0	4	0	0	3	0	209
059	Driftfish	0	3	0	0	52	0	1	3	0	0	0	0	59
090	Black Marlin	0	1	0	0	14	0	0	0	0	0	0	0	15
096	White Shark	0	0	0	0	2	0	0	0	0	0	0	0	2
097	Deepwater Dogfish	0	1	1	0	699	1	0	1	0	0	2	1	706
127	Remora	0	0	1	0	7996	2	0	0	0	0	0	52	8051
129	Unidentified Manta (Mobula)	0	0	0	0	22	0	0	0	0	0	0	0	22
132	Giant Manta Ray	0	0	0	0	12	0	0	0	0	0	0	0	12
133	Devil Ray	0	1	0	0	57	0	0	0	0	0	0	2	60
136	Cookie Cutter Shark	0	0	0	0	29	0	0	0	0	0	0	0	29
137	Gray Reef Shark	0	0	0	0	3	0	0	0	0	0	0	0	3
138	Oceanic White-tip Shark	0	1	0	0	2326	2	0	0	0	0	1	108	2438
139	Silky Shark	0	2	2	0	1702	2	0	0	0	0	1	50	1759
142	Tiger Shark	0	0	0	0	38	0	0	0	0	0	1	1	40
143	Crocodile Shark	0	0	1	0	1401	1	0	0	0	0	1	8	1412
148	Pelagic Thresher Shark	0	0	0	0	409	2	0	0	0	0	0	9	420

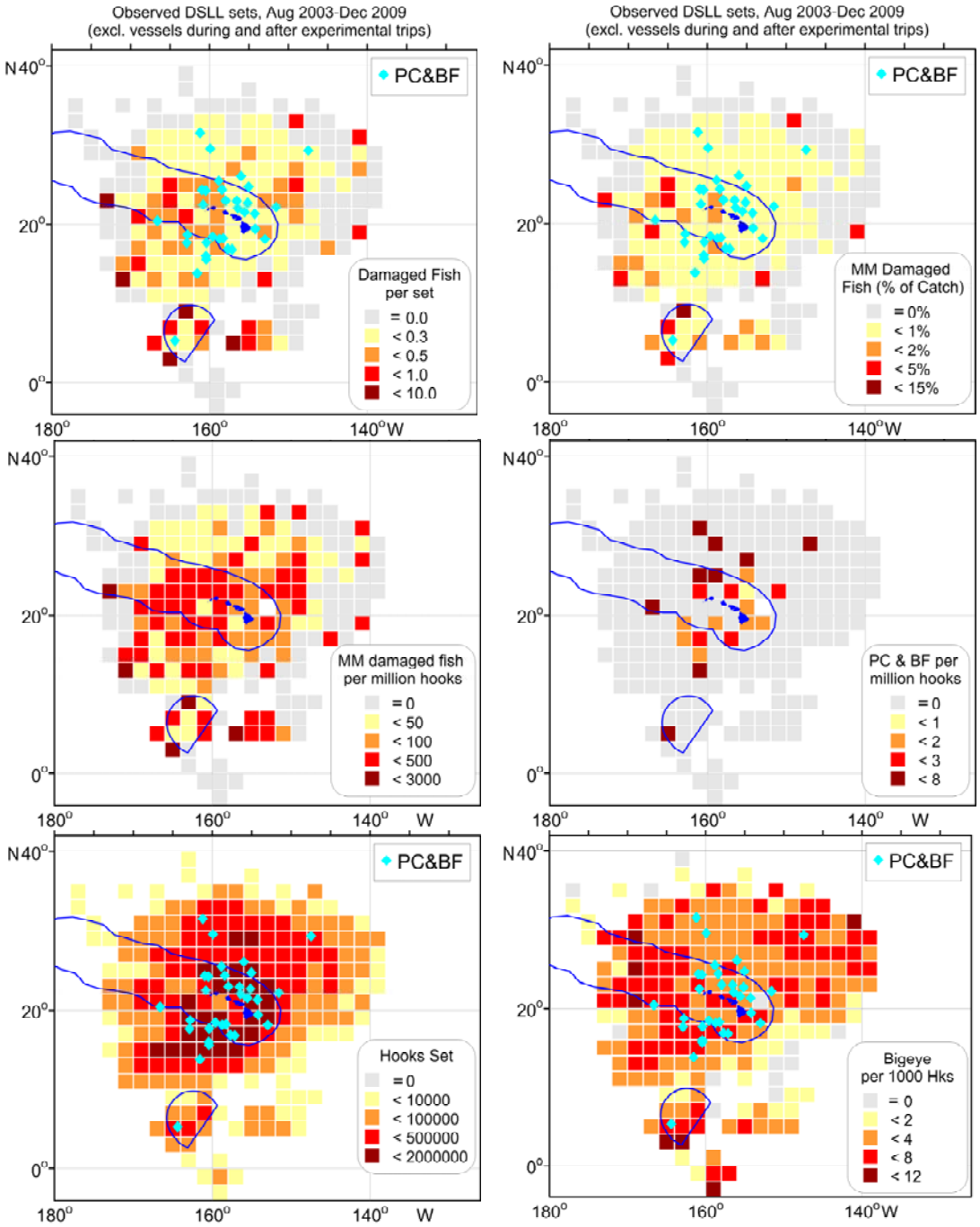
149	Blacktip Shark	0	0	0	0	2	0	0	0	0	0	0	0	2
151	Shortfin Mako Shark	1	28	3	0	7475	16	6	2	0	0	2	117	7650
155	Common Thresher Shark	0	0	0	0	16	0	0	0	0	0	0	0	16
157	Unid. Hammerhead Shark	0	0	0	0	15	0	0	0	0	0	0	0	15
158	Smooth Hammerhead Shark	0	1	0	0	41	0	0	0	0	0	0	1	43
167	Blue Shark	5	46	66	0	136991	66	8	3	3	1	36	5651	142876
170	Unidentified Ray	0	0	0	0	5	0	0	0	0	0	0	0	5
191	Louvar	0	0	0	0	3	0	0	0	0	0	0	0	3
193	Pelagic Stingray	0	69	3	0	7022	3	1	2	0	0	4	89	7193
290	Rough Triggerfish	0	0	0	0	5	0	0	0	0	0	0	0	5
291	Unid. Triggerfish	0	0	0	0	1	0	0	0	0	0	0	0	1
292	Common Mola	0	0	0	0	171	0	0	0	0	0	0	6	177
293	Pelagic Puffer	0	3	0	0	404	1	0	11	0	0	1	1	421
294	Sharptail Mola	0	0	0	0	52	0	0	0	0	0	0	0	52
445	Flying Fish	0	0	0	0	3	0	0	0	0	0	0	0	3
472	Hammerjaw	0	0	7	0	232	1	0	8	0	0	10	3	261
902	Scalloped Ribbonfish	0	2	0	0	7	0	0	0	0	0	0	1	10
903	Brama Pomfret	2	19	3	0	1563	6	2	44	3	0	3	2	1647
904	Rough Pomfret	0	4	1	0	315	1	0	2	0	0	0	0	323
905	Shortnose Lancetfish	0	0	0	0	2	0	0	0	0	0	0	0	2
907	Dagger Pomfret	0	37	0	0	2286	3	0	9	0	0	0	11	2346
911	Oarfish	0	0	0	0	3	0	0	0	0	0	0	0	3
912	King of the Salmon	0	0	0	0	1	0	0	0	0	0	0	0	1
913	Pompano Dolphinfish	1	28	1	0	631	7	1	44	3	0	3	0	719
915	Pacific Pomfret	0	0	0	0	94	2	0	4	1	0	1	0	102
917	Bigtooth Pomfret	0	0	0	0	3	0	0	0	0	0	0	0	3
918	Lustrous Pomfret	0	1	0	0	365	1	0	4	1	0	0	0	372
919	Ray, Other identified	0	0	0	0	8	0	0	0	0	0	0	0	8
935	Shark, identified	0	0	0	0	15	0	0	0	0	0	0	4	19
936	Unidentified Shark	0	0	0	0	1064	0	0	0	0	0	2	395	1461
937	UnidThresher Shark	0	0	1	0	726	1	0	0	0	0	0	105	833
938	Longfin Mako Shark	0	0	0	0	236	1	1	0	0	0	0	2	240
939	Unid. Mako Shark	0	0	0	0	129	1	0	0	0	0	0	91	221
942	Salmon Shark	0	1	1	0	37	0	0	0	0	0	0	0	39
943	Sandbar Shark	0	0	0	0	119	1	0	0	0	0	0	4	124
944	Bignose Shark	0	0	0	0	5	0	0	0	0	0	0	0	5
947	Galapagos Shark	0	0	0	0	37	0	0	0	0	0	0	1	38
949	Scalloped Hammerhead Shark	0	0	0	0	21	0	0	0	0	0	0	2	23

Species Code	Species common name	BD	CC	CO	MM	ND	SB	SH	SQ	ST	SW	UN	UO	TOTAL CATCH
006	Unid. tuna	0.0%	0.8%	0.9%	53.7%	14.2%	3.1%	20.1%	0.4%	0.3%	0.0%	1.3%	5.0%	100.0%
089	Unid. billfish	0.3%	0.3%	2.3%	47.7%	25.5%	1.3%	11.5%	0.0%	0.0%	0.0%	2.6%	8.6%	100.0%
700	Unid. bony fish	0.0%	0.4%	1.7%	4.8%	57.7%	0.8%	6.6%	1.1%	0.3%	0.0%	5.9%	20.6%	100.0%
058	Rainbow Runner	0.0%	2.7%	0.0%	2.7%	83.8%	1.4%	4.1%	1.4%	2.7%	0.0%	1.4%	0.0%	100.0%
094	Shortbill Spearfish	0.0%	2.3%	0.1%	1.1%	92.3%	1.0%	1.8%	0.8%	0.3%	0.0%	0.1%	0.2%	100.0%
910	Other bony fish	0.0%	1.0%	0.3%	1.0%	92.3%	0.3%	0.7%	2.4%	0.0%	0.0%	0.7%	1.0%	100.0%
057	Wahoo	0.0%	3.7%	0.1%	1.0%	90.0%	1.4%	2.0%	1.1%	0.4%	0.0%	0.2%	0.1%	100.0%
906	Crestfish	0.0%	2.4%	0.3%	0.8%	88.5%	0.5%	0.8%	5.6%	0.0%	0.0%	0.3%	0.8%	100.0%
916	Bigeye Tuna	0.0%	6.6%	0.1%	0.7%	90.8%	0.7%	0.4%	0.3%	0.3%	0.0%	0.0%	0.1%	100.0%
092	Striped Marlin	0.0%	2.8%	0.1%	0.7%	93.7%	1.0%	0.8%	0.4%	0.2%	0.0%	0.1%	0.2%	100.0%
095	Sailfish	0.0%	2.7%	0.0%	0.6%	94.4%	1.2%	0.4%	0.2%	0.0%	0.0%	0.0%	0.4%	100.0%
002	Skipjack Tuna	0.0%	4.5%	0.2%	0.6%	86.1%	2.0%	2.0%	3.2%	0.9%	0.0%	0.3%	0.2%	100.0%
901	Tapertail Ribbonfish	0.0%	5.4%	0.0%	0.5%	88.6%	1.1%	0.0%	2.7%	0.0%	0.0%	1.1%	0.5%	100.0%
054	Longfin Escolar	0.0%	0.8%	0.2%	0.5%	91.4%	0.5%	0.7%	3.3%	0.4%	0.0%	1.8%	0.6%	100.0%
467	Opah	0.0%	12.0%	0.1%	0.4%	86.2%	0.4%	0.1%	0.4%	0.1%	0.0%	0.1%	0.2%	100.0%
001	Yellowfin Tuna	0.0%	6.6%	0.1%	0.4%	89.1%	1.7%	0.9%	0.7%	0.4%	0.0%	0.1%	0.0%	100.0%
914	Mahi	0.0%	3.4%	0.1%	0.4%	92.6%	0.5%	1.1%	1.5%	0.1%	0.0%	0.1%	0.3%	100.0%
091	Swordfish	3.0%	22.5%	1.1%	0.4%	69.5%	1.5%	0.5%	0.5%	0.5%	0.0%	0.1%	0.4%	100.0%
093	Blue Marlin	0.0%	1.6%	0.1%	0.4%	95.3%	1.6%	0.2%	0.3%	0.2%	0.0%	0.1%	0.2%	100.0%
005	Albacore Tuna	0.1%	1.8%	0.1%	0.3%	95.0%	0.7%	0.8%	0.6%	0.5%	0.0%	0.0%	0.1%	100.0%
298	Slender Mola	0.0%	0.1%	0.0%	0.2%	98.0%	0.3%	0.5%	0.6%	0.1%	0.0%	0.0%	0.1%	100.0%
908	Sickle Pomfret	0.0%	1.5%	0.0%	0.2%	97.7%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	100.0%
131	Great Barracuda	0.0%	0.1%	0.0%	0.2%	98.9%	0.3%	0.3%	0.0%	0.1%	0.0%	0.0%	0.1%	100.0%
013	Smith's Escolar	0.1%	9.0%	0.2%	0.1%	87.0%	1.2%	0.8%	1.1%	0.2%	0.0%	0.1%	0.2%	100.0%
909	Longnose Lancetfish	0.0%	0.2%	0.3%	0.1%	94.3%	0.4%	0.8%	1.3%	0.2%	0.0%	0.6%	2.0%	100.0%
295	Snake Mackerel	0.0%	0.3%	0.1%	0.1%	92.4%	0.5%	0.8%	3.6%	0.3%	0.0%	0.4%	1.4%	100.0%
147	Bigeye Thresher Shark	0.0%	0.1%	0.0%	0.0%	97.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	2.2%	100.0%
004	Bluefin Tuna	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
014	Oilfish	0.3%	3.6%	0.2%	0.0%	92.9%	0.9%	0.6%	0.9%	0.3%	0.0%	0.1%	0.2%	100.0%
040	Yellowtail	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
042	Cottonmouth Jack	0.0%	0.0%	0.0%	0.0%	92.5%	0.0%	0.0%	2.5%	0.0%	0.0%	5.0%	0.0%	100.0%
051	Pacific Mackerel	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
053	Razorback Scabbardfish	0.0%	0.0%	0.0%	0.0%	92.1%	0.0%	0.0%	5.6%	1.6%	0.0%	0.0%	0.8%	100.0%
056	Roudi's Escolar	0.0%	1.9%	0.0%	0.0%	93.8%	1.0%	0.0%	1.9%	0.0%	0.0%	1.4%	0.0%	100.0%
059	Driftfish	0.0%	5.1%	0.0%	0.0%	88.1%	0.0%	1.7%	5.1%	0.0%	0.0%	0.0%	0.0%	100.0%
090	Black Marlin	0.0%	6.7%	0.0%	0.0%	93.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
096	White Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
097	Deepwater Dogfish	0.0%	0.1%	0.1%	0.0%	99.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.3%	0.1%	100.0%
127	Remora	0.0%	0.0%	0.0%	0.0%	99.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	100.0%
129	Unidentified Manta (Mobula)	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
132	Giant Manta Ray	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
133	Devil Ray	0.0%	1.7%	0.0%	0.0%	95.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%	100.0%
136	Cookie Cutter Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
137	Gray Reef Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
138	Oceanic White-tip Shark	0.0%	0.0%	0.0%	0.0%	95.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	4.4%	100.0%
139	Silky Shark	0.0%	0.1%	0.1%	0.0%	96.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	2.8%	100.0%
142	Tiger Shark	0.0%	0.0%	0.0%	0.0%	95.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%	2.5%	100.0%
143	Crocodile Shark	0.0%	0.0%	0.1%	0.0%	99.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.6%	100.0%
148	Pelagic Thresher Shark	0.0%	0.0%	0.0%	0.0%	97.4%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%	100.0%

149	Blacktip Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
151	Shortfin Mako Shark	0.0%	0.4%	0.0%	0.0%	97.7%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	1.5%	100.0%
155	Common Thresher Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
157	Unid. Hammerhead Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
158	Smooth Hammerhead Shark	0.0%	2.3%	0.0%	0.0%	95.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	100.0%
167	Blue Shark	0.0%	0.0%	0.0%	0.0%	95.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%	100.0%
170	Unidentified Ray	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
191	Louvar	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
193	Pelagic Stingray	0.0%	1.0%	0.0%	0.0%	97.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.2%	100.0%
290	Rough Triggerfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
291	Unid. Triggerfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
292	Common Mola	0.0%	0.0%	0.0%	0.0%	96.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	100.0%
293	Pelagic Puffer	0.0%	0.7%	0.0%	0.0%	96.0%	0.2%	0.0%	2.6%	0.0%	0.0%	0.2%	0.2%	100.0%
294	Sharptail Mola	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
445	Flying Fish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
472	Hammerjaw	0.0%	0.0%	2.7%	0.0%	88.9%	0.4%	0.0%	3.1%	0.0%	0.0%	3.8%	1.1%	100.0%
902	Scalloped Ribbonfish	0.0%	20.0%	0.0%	0.0%	70.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	100.0%
903	Brama Pomfret	0.1%	1.2%	0.2%	0.0%	94.9%	0.4%	0.1%	2.7%	0.2%	0.0%	0.2%	0.1%	100.0%
904	Rough Pomfret	0.0%	1.2%	0.3%	0.0%	97.5%	0.3%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	100.0%
905	Shortnose Lancetfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
907	Dagger Pomfret	0.0%	1.6%	0.0%	0.0%	97.4%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.5%	100.0%
911	Oarfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
912	King of the Salmon	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
913	Pompano Dolphinfish	0.1%	3.9%	0.1%	0.0%	87.8%	1.0%	0.1%	6.1%	0.4%	0.0%	0.4%	0.0%	100.0%
915	Pacific Pomfret	0.0%	0.0%	0.0%	0.0%	92.2%	2.0%	0.0%	3.9%	1.0%	0.0%	1.0%	0.0%	100.0%
917	Bigtooth Pomfret	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
918	Lustrous Pomfret	0.0%	0.3%	0.0%	0.0%	98.1%	0.3%	0.0%	1.1%	0.3%	0.0%	0.0%	0.0%	100.0%
919	Ray, Other identified	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
935	Shark, identified	0.0%	0.0%	0.0%	0.0%	78.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.1%	100.0%
936	Unidentified Shark	0.0%	0.0%	0.0%	0.0%	72.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	27.0%	100.0%
937	UnidThresher Shark	0.0%	0.0%	0.1%	0.0%	87.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	12.6%	100.0%
938	Longfin Mako Shark	0.0%	0.0%	0.0%	0.0%	98.3%	0.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.8%	100.0%
939	Unid. Mako Shark	0.0%	0.0%	0.0%	0.0%	58.4%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	41.2%	100.0%
942	Salmon Shark	0.0%	2.6%	2.6%	0.0%	94.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
943	Sandbar Shark	0.0%	0.0%	0.0%	0.0%	96.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%	100.0%
944	Bignose Shark	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
947	Galapagos Shark	0.0%	0.0%	0.0%	0.0%	97.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.6%	100.0%
949	Scalloped Hammerhead Shark	0.0%	0.0%	0.0%	0.0%	91.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	100.0%

Attachment 5

Work Group Update 3 (prepared by Karin Forney) 3/23/2010

<u>Looking at PC&BF bycatch per unit effort :</u>

The top two panels (depredation) and the lower right panel (bigeye catch) are the same as before; the other three panels show PC&BF bycatch per million hooks, depredation per million hooks, and total number of hooks within the 2003-2009 observer database.